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ORIGINAL MEMOIRS.

METHOD OF SUTURING THE PROLAPSED KIDNEY.[1]

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I PRESENT herein a technique for fixation of the kidney that I have employed with satisfactory results for the past three years. During this time—since September 14, 1900, when I first made use of it—I have done by this method 171 consecutive nephropexies on 134 patients, in thirty-seven both kidneys at the same time, without a death and without a failure to secure sufficient fixation. I make it a point to follow up my cases and submit them repeatedly to examination after operation. In only one of my cases within the past three months I have discovered, upon recent examination, that the left kidney, which was fixed with its fellow on June 23, is not entirely immovable. The patient is a very thin subject, and the kidney can be palpated and moved upward, but the movement downward is restricted, so that the result may be regarded as satisfactory.

[1] Read before the Surgical Section of the New York Academy of Medicine, October 12, 1903.

The explanation of the incomplete fixation in this case is that the patient's condition was most unfavorable for operation at the time it was undertaken, and there was unusual retching and vomiting following the anæsthetic, both at that time and some ten days later, when an abdominal section was done for intrapelvic disease.

There are several points I find essential for success with this as well as any other method of technique employed for this condition, namely,—

(1) The patient should be carefully prepared so as to obviate or minimize the disturbance produced by the anæsthetic and consequent retching and vomiting following the operation.

(2) Particular care should be taken to completely detach the colon from the kidney, so as to obviate subsequent dragging upon it when the bowel becomes distended, which will either tear it loose or cause pain.

(3) Reattachment of the colon to the kidney must be prevented. This can be done by packing a gauze drain under and in front of the kidney and resorting to early evacuation of the bowel.

(4) The sustaining sutures must be inserted under the fibrous capsule in a manner to obviate tearing or cutting through that structure when they are tied, and the suture material must be one that does not soften, stretch, or absorb, as this would permit the kidney to drag upon its attachment before it is firm. For the same reason the sutures should not be tied to the muscles, but should be brought out upon the surface of the back and tied as described in the technique below. Nor must the sutures be removed until sufficient time is allowed for firm attachment.

(5) The kidney must be restored by the operation to its normal position, and should not be attached lower down than normal, where it may become compressed by the corsets or clothing around the waist.

(6) The detached, redundant fatty capsule must not be permitted to become insinuated between the kidney and the structures to which it is desired to have it adhere. As this

may occur after closure of the wound, I favor the packing of gauze around the lower pole of the kidney, which is retained for forty-eight hours.

(7) The patient must be kept strictly on the back during the period of confinement to bed when both kidneys are involved; or should be turned only on the affected side when one kidney has been subjected to the operation; and she must not be permitted to get up earlier than three weeks.

(8) The operation should be resorted to before the health of the patient is seriously impaired and before the kidney has become seriously disabled or diseased.

(9) Conditions dependent upon the prolapse must receive attention as well, and should be corrected after operation.

Technique of the Operation.—The patient when anæsthetized is placed prone upon the table, with an air-pillow under

FIG. 1.

Author's blunt hooks.

the abdomen, which increases the costo-iliac space by bending the spine forward and forces the kidney up into position. A vertical incision is made through the skin and fat down to the first layer of muscles, beginning just below the last rib and extending downward parallel to the outer border of the erector spinæ muscle for about three and a half inches. The thin fascia or sheath covering the first layer of muscle is divided with scissors to the extent of the incision above and below; and the muscle beneath (the latissimus dorsi) is separated in the direction of its fibres by means of blunt hooks and held apart by broad retractors. (Fig. 1.) Keeping to the outer side of the erector spinæ muscle, the fascia attached to its border is penetrated and separated to the limit of the incision above and below by the blunt hooks also, and its margin included in the broad retractors (Fig. 2). This exposes the quadratus lumborum muscle, which is carefully drawn aside

and included in the retractor on the spinal side of the incision. Then, with blunt hooks the transversalis fascia is penetrated near the upper angle of the wound and split downward by trac-

FIG. 2.

Author's universal retractors.

tion upon the blunt hooks. This avoids wounding the iliohypogastric nerve and its accompanying vessel which crosses obliquely the line of incision in front of the quadratus lumborum muscle.

The margins of this fascia are also included in the broad retractors. The fatty capsule surrounding the kidney is exposed beneath this fascia and bulges up into the wound as soon as it is divided. A loop of intestine will usually protrude with this fat, and the operator must be careful to avoid it in opening the fatty capsule to expose the kidney.

The kidney is now located by inserting the finger and sweeping it around over the surface of its fatty investment, and will usually be found up in its normal position. The fatty capsule is dragged downward and opened with scissors well up towards the upper angle of the incision and well over towards the spine so as to avoid opening into the peritoneal cavity or wounding the intestine which bulges up into the wound, and the incision is extended in a vertical direction downward upon the finger as a guide. The margins of the fatty capsule on each side are seized with T-forceps, and traction is made upon them to bring the kidney up into the wound. In adjusting the T-forceps to the outer margin of the fatty capsule care should be taken not to include the intestine or peritoneum.

If the peritoneum is inadvertently opened in exposing the kidney, no harm will result if it is immediately closed by a running suture of fine catgut. The incision then to expose the kidney is to be made further over towards the spine. The acci-

dent should not occur if the kidney is in position and is properly located before the incision into its capsule is made.

The fatty capsule is detached from the kidney with the finger, aided by blunt-pointed scissors, where particularly resisting bands of adhesion are encountered. The lower pole of the kidney is freed first, then traction upon the fatty capsule will bring it up into the wound. If the kidney cannot be delivered through the incision by traction upon the capsule, the patient is rolled downward upon the air-pillow, which brings its pressure more directly upon the border of the ribs and forces the kidney up into the wound. To aid delivery of the kidney, it may be grasped with a pad of gauze held between the fingers and thumb.

It is not always necessary to deliver the kidney through the incision in order to detach the fatty capsule and insert the sustaining sutures; and it consumes more time. When, therefore, complete detachment can be readily accomplished without doing so, this part of the technique may be omitted.

The fatty capsule should be completely detached from the kidney around both poles and on each side back to the hilum. Thus complete detachment of the colon and duodenum in front is effected, and behind, the kidney is left bare of its fatty investment for subsequent adhesion to the muscles at the back.

The pelvis and ureter are always carefully explored for stone.

The fibrous capsule is not split or detached from the kidney, nor is its surface sacrificed. I have found this to be quite unnecessary. Firm adhesion of the kidney with its fibrous capsule intact can be invariably secured if the kidney is held immovably in contact with the opposing structures for a sufficient length of time. To accomplish this, however, the suture material should be one that does not stretch or become absorbed, and it must be inserted and tied so that the suture loop does not become loosened by cutting into the tissues. We have in silkworm gut a material that meets these requirements, and to render it pliable it is boiled and preserved in a 3 per cent. solution of lysol. My record of 171 nephropexies by this

method without a failure to secure fixation shows conclusively that stripping off the fibrous capsule or further mutilation of the kidney as by sutures which transfix the parenchyma is quite unnecessary.

The sustaining sutures, two in number, are inserted upon the posterior aspect of the free border of the kidney. One, the lower, is inserted at about the junction of the middle and lower thirds of the organ, and the other at about its centre or

FIG. 3.

Author's kidney needle.

midway between the poles. The suture is threaded into a small, full-curved needle one inch long, and it is bent sharply at the eye of the needle and twisted tightly to avoid tearing the capsule as it is drawn through (Fig. 3).

The sutures are introduced in this manner, viz.:

The needle is inserted first from above downward in a direction somewhat obliquely inward to the long axis of the kidney, and penetrates only beneath the fibrous capsule for about half an inch, and the suture is drawn through; then it is inserted transversely a little below the point of exit of the first insertion, penetrates beneath the fibrous capsule, about half an inch, and the suture is drawn through; then it is again inserted obliquely from below upward at a point opposite the first insertion, about an inch from it, and the suture is carefully drawn through (Fig. 4). The needle is removed, and the two ends are clasped temporarily with a hæmostatic forceps.

The second suture is inserted in a similar manner just above the first.

Thus, it will be seen that there are three insertions of the suture under the fibrous capsule and two bridges of suture exposed on the outer side of the fibrous capsule. It is upon these two bridges of exposed suture that the strength of the suture depends. In testing this suture, it will be observed that

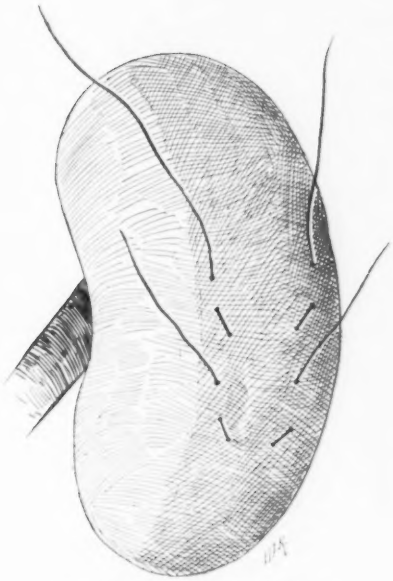

FIG. 4.—Author's suture inserted.

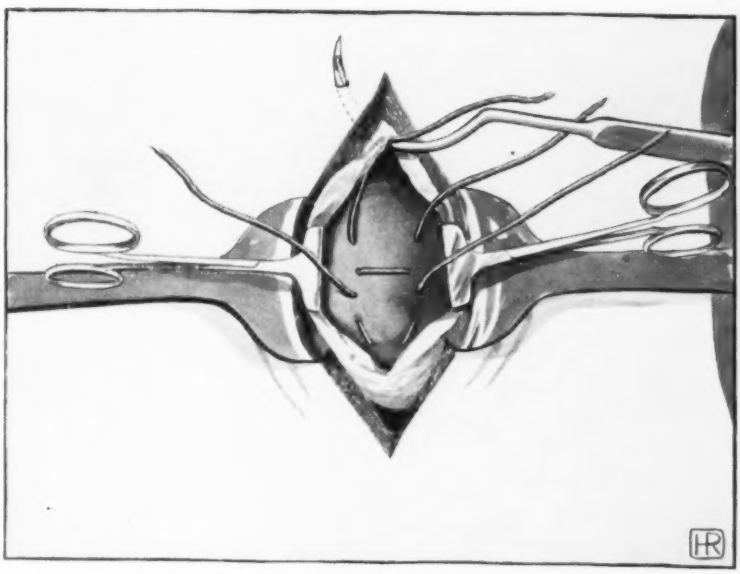

FIG. 5.—Showing suture in position and method of carrying the ends of the suture through the structures of the back and bringing them out on the surface at the upper angle of the wound.

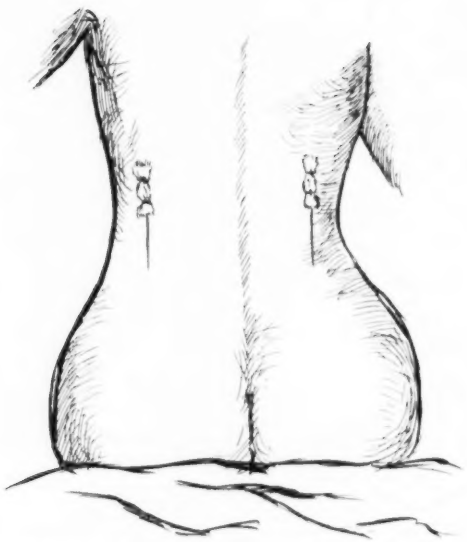

FIG. 6.—Sustaining sutures tied over fold of gauze to prevent loosening of the suture loop.

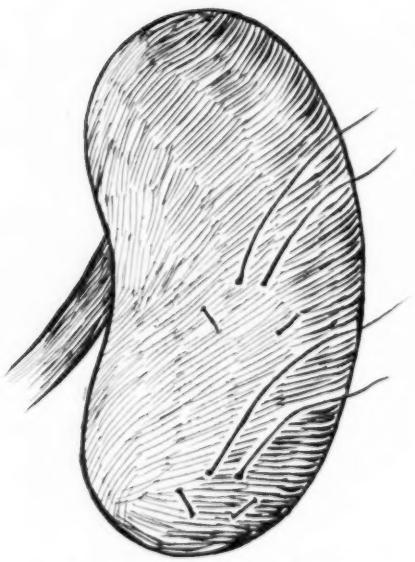

FIG. 7.—The Brödel suture, for comparison.

the strain upon it is in a direction parallel to the surface of the kidney and its capsule, and not at right angle to it, as is the case with the transverse suture and all other forms of sutures employed for the purpose of sustaining the kidney. This suture will resist a very considerable strain upon it without cutting out, very many times more strain than the transverse suture which penetrates the parenchyma or any suture inserted through the detached fibrous capsule, and it does not mutilate.

Before replacing the kidney into its normal position, the redundant fatty capsule behind is trimmed off with scissors or torn off, and that in front also, but here care is necessary to avoid encroaching upon the peritoneum or bowel. The fat about the lower pole is not removed, but left to form a cushion for the kidney to rest upon.

The ends of the sustaining sutures that have been inserted into the kidney are carried through all the structures of the back and brought out on the surface at the upper angle of the incision,—a long, curved, perineal needle with eye near the point being utilized for this purpose (Fig. 5). The sutures are tied over a fold of several layers of gauze placed lengthwise to the incision at its upper end. This forms a cushion for the suture-loop to rest upon and prevents the sutures from cutting through the skin and consequent loosening of the loop (Fig. 6). When tied, these sutures bring the kidney up into its normal position, with its upper pole under the ribs.

A gauze drain is now packed about and under the lower pole of the kidney, forcing back the fat that has not been removed and the bowel which bulges up below the kidney, and its end is brought out at the lower angle of the wound.

The wound is closed by uniting the divided superficial fascia and upper borders of the muscle with a running catgut suture, and the skin is united with a subcuticular suture. A bountiful supply of loose, aseptic gauze is applied next to the wound, and over this is placed a thick pad of absorbent cotton covered with gauze, and this is held in place by adhesive strips and a binder encircling the body.

In many cases where the fatty capsule is thin or not redun-

dant, I dispense with the gauze packing and drain, closing the wound without it, and this method has succeeded quite as well as where the gauze drain was employed.

After-Care of the Wound and of the Patient.—When drainage is employed, the dressings are removed at the end of twenty-four hours, as they are usually found soaked and make the patient uncomfortable. At the end of forty-eight hours the gauze drain is removed and the dressing renewed; after this the dressing is renewed when necessary.

The sustaining sutures are not removed until the twentieth day, or the day before the patient gets out of bed. The exposed portion of the loop of each suture on one side of the gauze cushion is cut, and the suture pulls out readily, adhering to the gauze when it is lifted off. A simple dressing of gauze is applied afterwards.

When renewing the dressings, the patient should be turned on the affected side, to obviate dragging on the freshly attached kidney; and, if both kidneys have been fixed at the same time, she should be turned preferably on the right side, since it is the right kidney that is usually most displaced; but in those cases where the left kidney at the time of operation has been found to be the larger, she should be turned on that side in renewing the dressing. During the time of convalescence, while in bed, she must be kept upon the back, or turned only on the right side, if it was the right kidney that had been fixed.

The only other suture that resembles this, which I first described in the *Medical Record* of June 1, 1901, and repeatedly since (*Philadelphia Medical Journal*, October 26, 1901; *American Medicine*, December 28, 1901; *International Medical Magazine*, March, 1902), and which I first employed on September 14, 1900, and the second time, October 18, 1900, is the Brödel suture, first used by Cullen, of Baltimore, October 26, 1900, a description of which was first published by Brödel in *American Medicine* of August 2, 1902 (Fig. 6).

The essential differences between the Brödel suture and the one which I have just described are as follows:

(1) The apex of the triangle formed by the suture is above, the ends emerging on the surface of the kidney near together. In my suture the apex of the triangle is below, the ends of the suture emerging on the surface more apart from each other, because they are brought out and tied on the external surface.

(2) The sutures are placed at a greater distance apart, the lower suture at the lower pole; and they include less area of surface. My suture does not include the lower pole, which is left normally free, and it includes a larger area of surface.

(3) The suture material is silk, while mine is silkworm gut.

(4) The sutures are tied to and buried in the muscles, while mine are brought out upon the surface and tied over a pad of gauze.

THE GAUZE-BEARING TAPE AND THE GRAVITY PAD IN PELVIC AND ABDOMINAL SURGERY; IMPROVEMENTS IN TECHNIQUE.[1]

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THE practical advantages of an unlimited supply of dry gauze for sponging and for confining the intestines to the upper portion of the abdominal cavity, in order to facilitate surgical manipulations and at the same time protect the healthy peritoneum from contact with irritating fluids and exposed areas of infection, as compared with the usually restricted number of marine sponges, or of moist gauze pads, during the performance of an abdominal section, are no longer questioned by surgeons of experience; but the special merit that still attaches to the employment of the latter is the almost constant and comparatively small number of sponges required for the purpose; by the practice of repeated rinsings these may be limited to ten or twelve, counts that can be readily and quickly made by both the surgeon and his assistants before closing the abdomen.

This question of supply in point of numbers is the only tenable, but an all-important, and to many surgeons an overshadowing, objection to the use of the dry pads, of which from fifty to a hundred, and frequently more, are required in a given operation. The larger the number in use the greater the danger of a miscount on the part of the nurse, or the loss of one or more by the surgeon or his assistant within or without the abdominal cavity, while the time consumed in search-

[1] Read before the Philadelphia Obstetrical Society, October 1, 1903.

ing for a missing pad, however it may be accounted for eventually, is always a source of anxiety to both surgeon and assistants, and often leads to harmful manipulation and exposure of the abdominal contents, resulting, in many instances, in superadded shock of sufficient severity to determine a change in the vital balance of the patient towards an unfavorable issue. Even after a most painstaking and prolonged search, a lost piece of gauze may be overlooked by being hid in one of the numerous recesses of the cavity, or, by becoming enveloped in a fold of omentum or mesentery, it may lead to a mistaken identity of same for one of the abdominal viscera; or, finally, the patient's condition may have become such that, in order to escape the shocking experience of witnessing a death on the operating table, the further prosecution of a long-continued hunt may be abandoned, with the surgeon's mind in doubtful contemplation of having closed the abdomen with a retained foreign body. Although the writer's confidence in his ability to avoid this accident was almost absolute, he at last found himself in the meshes of such a dilemma several weeks ago, and, while the patient made an uninterrupted recovery, the lost sponge to this day remains unaccounted for. Although he has never experienced the graver misfortune of having had a death from such a cause, yet he has known it to occur, and has himself removed gauze introduced by a surgeon of eminence at a previous operation in addition to assisting others for a like purpose. The danger, therefore, of closing the abdomen with retained gauze has been presented to his mind in real form by others, and as a possibility at his own hands, with sufficient frequency to deter him, until recently, from using any but the usually limited number of moist gauze pads with all their objectionable features.

Dry gauze pads with trailers have likewise failed to solve this perplexing problem. The trailer may become detached or lost with the pad. Grasping projecting ends of individual pieces of gauze with hæmostats, advocated by some, necessarily narrows the abdominal opening, and thus embarrasses the

surgeon in his manipulations, while the possible accidental detachment of the forceps is another objection to this method.

But with the use of numerous pads, even, as ordinarily made, aided by the Trendelenburg posture, it is frequently difficult to confine the intestines to the upper abdominal area. Excessive intra-abdominal pressure, supplemented by the contraction of the abdominal muscles as a result of ineffectual etherization, and the spasmodic action of the diaphragm attending nausea and vomiting, frequently force intestinal loops into the field of operation in spite of every effort on the part of the surgeon to prevent it.

Both of these objectionable features in the technique of abdominal sections, especially in appendectomies with pus formation and in operations for the removal of diseased structures from the female pelvis, have been practically removed by the introduction, at St. Joseph's Hospital, Philadelphia, of two simple devices, named by the writer the "Gauze-bearing Tape" and the "Gravity Pad" respectively.

The one obviates the annoyance of a miscount in the number of gauze pads used for isolating and exposing the field of operation, and positively eliminates the danger of the loss of any within the abdominal cavity, at the same time minimizing the possibility of losing unsecured pads for rapid sponging, while the other supplements and enhances the advantages of the Trendelenburg position.

The gauze-bearing tape consists of a piece of white tape about half an inch in width and of variable length (three or four feet), armed at one end with a long, blunt-pointed needle or bodkin.

The gravity pad is nothing more than a large gauze pad, concealed within its folds and fastened to the centre of which is a lead plate measuring two by three inches, and weighing half a pound. Instead of a single piece of lead, smaller plates of the metal may be held in quilted squares of the pad or at indifferent points. The pad is provided with a trailer. This, however, is not considered essential, for the reason that but one, and rarely two, is required during an operation, and if

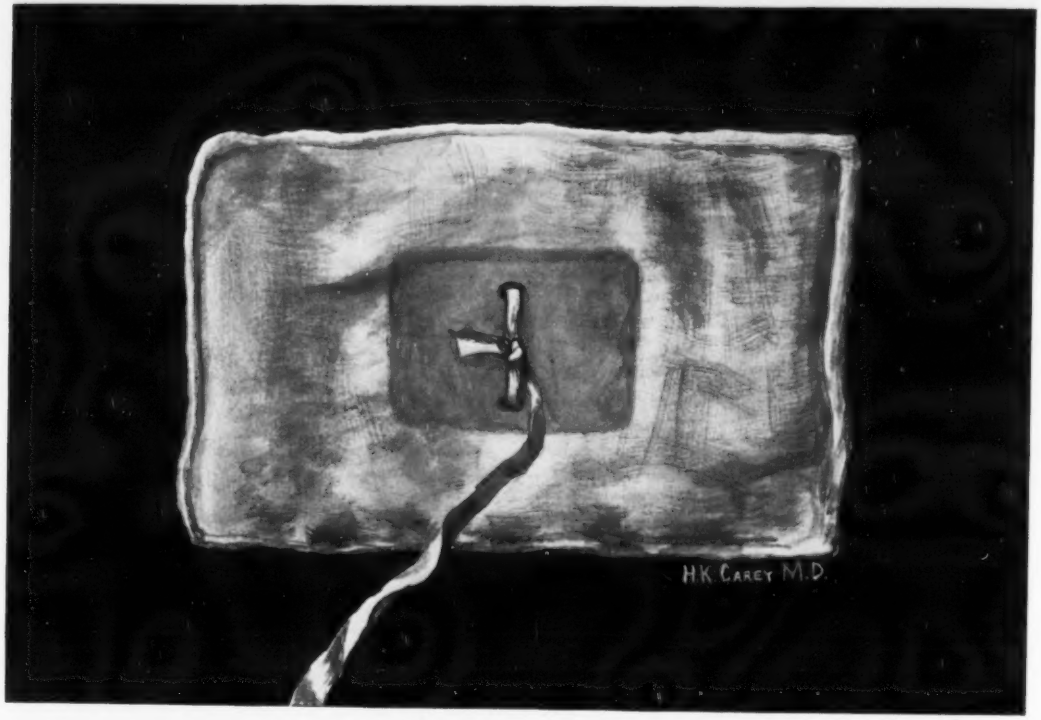

FIG. 1.—Gravity-pad with concealed lead plate in the centre.

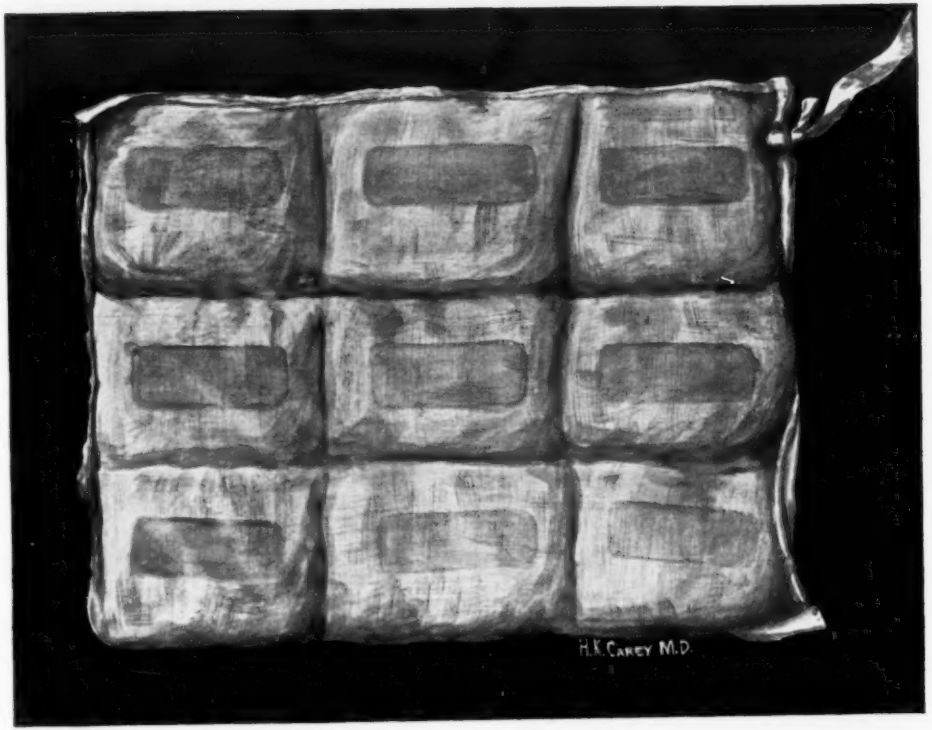

FIG. 2.—Gravity-pad with lead plates concealed in quilted squares.

desired their safety against loss may be rendered absolute by using them in connection with the tape.

The practical utility of the gauze-bearing tape was first demonstrated by the writer on July 27, 1903, in an operation for the removal of an interligamentary fibroid of the uterus complicated by cystically diseased appendages, evidently of inflammatory origin, forming masses that were firmly bound to the rectum and floor of the pelvis. A pelvis clear of intestines and a good view of the parts were essential to doing the required work with safety to bladder and rectum, and to secure these a number of gauze pads were called for to hold the intestines at a proper level and expose the field of operation. One end of a long piece of gauze was introduced into the abdomen, while the nurse quickly, and without any loss of time to the operator, perforated the other extremity with the needle and tape, securing its edge to the distal end of the latter with a turn-over tie; after the entire pad had been packed into the cavity with the free portion of the tape trailing from the abdominal opening, other pads were strung on the tape in a like manner, but without the necessity of securing them with a knot, the first and successive pads acting as points of fixation for those that followed. No account was taken of the pads thus introduced, nor was this necessary, for the reason that, after a sufficient number were in use to answer the purpose indicated, the removal of same upon the completion of the operation simply depended upon the withdrawal of the tape to which all were attached. On the following day the same device was used with entire satisfaction in an operation for suppurative appendicitis, while the combined advantages of the gravity pad and the tape were first employed in an unusually trying case of suppurative disease of the uterine appendages. The latter patient took ether badly; the abdominal muscles were rigid, and the intra-abdominal pressure was of a character to try one's patience and skill with the means usually at hand to isolate and expose the diseased field. With the patient in the Trendelenburg position, and after relieving adhesions to omentum and coils of intestine, one gravity

pad was introduced, and with the aid of a few gauze sponges strung on a tape, as in the previous operation, the intestines were held at a proper level, thus permitting satisfactory manipulations in the pelvis. As was illustrated in this particular patient, weight properly distributed is of more importance than bulk in holding back intestines. Without the gravity pad, three times the quantity of gauze would not have given the same satisfactory result. By the use of this pad, the certainty, not alone of confining the intestines to the upper abdominal cavity, but the maintenance of a more or less immovable wall against which gauze may be packed to isolate the field of operation and protect the healthy peritoneum from contact with infecting materials, seems to be assured. Final judgment bearing upon its utility and proper application in practice, however, must be founded upon a greater experience than its use in the single case reported.

Since writing the foregoing, the gauze-bearing tape has been employed in several abdominal operations with such uniform satisfaction that the writer feels inclined to continue its use until a more certain method, or a simpler device, is presented to safeguard the surgeon against the loss of a sponge within the abdominal cavity, an accident that is rarely reported, although it has befallen some of the most experienced, and very many of the most careful and eminently painstaking, operators of our day.

Unfortunately for the medical profession at large, human nature among surgeons, with but few exceptions, seems to be about the same the world over. In their efforts to secure a perfect surgical technique, the reports of failures in practice that tend to excite the fear of being classified as personal blunders rather than as errors of judgment do not find the many champions in the columns of our medical journals that the seriousness of the situation in many instances demands, and this applies with especial force to the publication of cases of closure of the abdomen with retained sponges or pieces of gauze.

TRAUMATIC EPILEPSY.[1]

REPORT OF A CASE IMPROVED BY TREPHINING AND INSERTION OF A CELLULOID PLATE BENEATH THE SKULL.

BY JOHN C. McCOY, M.D.,

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THE history of traumatic epilepsy and operation for its relief has been and is rather unsatisfactory so far as absolute cure is concerned. There is, however, no question but that in a considerable number of the more aggravated forms, while surgical intervention cannot promise a permanent arrest of the epileptic seizures, it may and does, at times, very greatly reduce their frequency and severity.

The results obtained by operation must depend largely upon the amount of damage occasioned by the trauma, and the accompanying development of new connective tissue at the seat of injury.

Though in the traumatic type, as a result of extensive laceration of brain tissue, we may not expect an absolute cure, we may in many cases look for a mitigation of the symptoms, and hope by the removal of a mass of cicatricial tissue, or elevation of a depressed fragment of bone, to not only attenuate the individual epileptic seizures, but also increase the period of time between the attacks, and perchance save the patient more serious trouble in later life.

When we consider the pathological changes which take place in the cortical and subcortical areas as the result of trauma and laceration, it is not surprising that our efforts in the line of surgical intervention are not followed by absolute relief of the epilepsy.

It matters not how carefully and thoroughly the surgeon may dissect away the cicatricial tissue which is acting as a

[1] Read at the annual meeting of New Jersey State Medical Society, June, 1903.

focus of irritation, there must inevitably remain, after his work is done, trabeculæ of connective tissue projecting from the limits of the operative field and permeating between the convolutions, or extending between the brain and dura. The adhesions, slight though they may be, will most probably continue to act as a source of irritation.

In cases of brain injury, where there has been more or less laceration of the cortical and subcortical tissues, it is the development of cicatricial tissue which, acting as a focus of irritation, eventually causes the epileptic seizures. Even after the careful removal of such tissue, we again have practically the same conditions present which existed at the time of injury.

In some cases the convulsive seizures may make their appearance immediately after the injury, or they may be deferred to a varying length of time thereafter, depending upon the period required for the cicatricial tissue to attain such proportions as, by its pressure and consequent irritation, to cause the epileptic seizures.

And since, after the removal of the cicatrix, the same conditions exist, we may look for an abatement of the seizures only until such time as the cicatricial tissue has again formed, when we will once more have, either in an attenuated or possibly a more aggravated form, the same conditions as existed prior to operation.

Operation is, however, in my opinion, justifiable in all cases where the epilepsy can be traced directly to recent trauma, since, while we cannot promise a cure, we may at least hold out the hope of partial relief.

The object then in all operations for this condition should be: (1) To remove as much as possible of the newly formed connective tissue. (2) To minimize as far as we are able the recurrent development of such tissues.

It is with the object of emphasizing more particularly this second point that the following case is reported.

On January 11, 1896, a boy, while on the sidewalk, was struck upon the top of the head by a piece of concrete thrown

from an upper story. Immediately after the injury, he was removed to the hospital in a semi-conscious condition; when spoken to sharply could be aroused and would answer questions in a perfunctory manner; would, however, immediately drop into a dull, apathetic state again. Upon the right side of the head, extending over the posterior portion of the frontal bone, was a lacerated wound, five centimetres in length.

Upon exploration, three detached fragments of bone, including the entire thickness of the skull, were exposed. The two large fragments in their median line were pressing down upon the brain, being at this point depressed at least two centimetres below the level of the skull. The third but smaller fragment, triangular in shape, was driven into the brain tissue.

The area included by the detached fragments extended over the frontal bone, from six centimetres anterior to the coronal suture, to four centimetres posterior to that suture over the parietal bone. The width of the area on the coronal suture was five centimetres, the widest part of the cavity was two centimetres anterior to the coronal suture, where the measurement was nearly seven centimetres. The entire length of the cavity was ten centimetres, and its greatest breadth seven centimetres; three centimetres anterior to the coronal suture was the base of the small triangular fragment, the apex, sharp and cutting, had been driven so far into the brain tissue that the base was just visible above the cortex.

Where the apex of this smaller fragment had been attached to the frontal bone, a fracture started, which, passing through the orbital arch, extended into the orbital plate of the frontal bone. Posteriorly, a fracture commenced where the apex of the larger triangular piece had been attached to the parietal bone. This fracture extended in an anteroposterior direction on a line parallel with the interparietal suture, and a little to the right of the line. Midway between this suture and the squamous suture, the fracture extended through the lambdoidal suture into the occipital bone for a distance of four centimetres. A third fracture extended directly down from the inner margin of the wound into the temporal fossa.

When the fragments were elevated, it was found that the dura over this entire area was so badly lacerated that it was necessary to remove the remaining shreds.

The brain tissue throughout the entire area was more or less lacerated, and in the anterior portion of the wound the subcortical tissue had been gouged out by the smaller fragment, leaving a cup-like depression four by three centimetres, with a depth of at least two centimetres. The lacerated tissue was removed and the edges of bone rounded off, and the scalp wound partially closed.

A small drainage tube was introduced into the anterior angle of the wound, passing into the cup-like depression in the brain, from which there was persistent oozing.

Subsequent History.—January 12, during first twenty-four hours following operation, the pulse varied from 120 to 146. Respiration, 27 to 36; temperature 100° to $102^{2}/_{5}$° F. Patient complained of pain in head, was very restless, and mental condition dull.

January 13, temperature $105^{2}/_{5}$° F., pulse 139, respiration 32. Tingling sensation in left arm and hand; arm and hand cold. Drainage removed; slight oozing.

January 14, temperature $104^{4}/_{5}$° F., pulse 132, respiration 32. At 3 P.M. patient had a convulsion lasting ten minutes. Twitching commenced in the left side of face and neck, extending to left arm and leg, and then became general. During the following nine hours he had eight general convulsive seizures lasting from one to twelve minutes. One of these convulsions, however, was slight in character, and was confined to the muscles of the head and neck on the left side.

January 15, highest temperature $104^{1}/_{5}$° F., pulse 127, respiration 26.

There was continued restlessness, accompanied by a very sluggish mental condition. One general convulsion lasting two minutes.

January 16, temperature $102^{1}/_{5}$° F., pulse 106, respiration 24. One slight convulsive seizure, confined to head and neck muscles, lasting two minutes.

Eight general convulsions lasting from two to fifteen minutes. Extremely restless and talkative, mental condition clearer. At the suggestion of Dr. M. Allen Starr, thirty grains of urethane were administered per rectum.

January 17, temperature $100^{4}/_{5}$° F., pulse 112, respiration 20 to 40. Eleven general convulsions lasting from five minutes to one hour.

January 18, temperature 101$^{3}/_{5}$° to 99$^{1}/_{5}$° F., pulse 99 to 135, respiration 24 to 30. Fourteen convulsions lasting from two to twenty-five minutes.

January 19, temperature 99° F., pulse 100, respiration 30. Three general convulsions lasting from three to fifteen minutes.

January 20, mental condition much improved; temperature 99$^{3}/_{5}$° F., pulse 94, respiration 28. No convulsions from this time, and the convalescence was uneventful. His general health remained good, excepting occasional headaches up to the 26th of March, 1898, over two years after the receipt of the injury. On this date he had a general convulsive seizure.

From the 26th of March to the 4th of December he had twelve convulsions.

On December 14, 1898, under the direction of Dr. M. Allen Starr, the scalp was opened and the following conditions found.

The scalp was adherent to a mass of dense connective tissue which covered the entire area from which the bone had been removed.

This cicatricial tissue was adherent to the edges of the bone, extended for a distance of two centimetres beyond the edges of the bone on the upper surface of the skull. It was closely adherent and incorporated with cortex over the entire area, and completely filled the cup-like depression in the anterior portion of the wound. This mass of cicatricial tissue was excised, the plug of tissue in the depression carefully removed, and the tissue dissected from the edges of the bone.

A celluloid plate two centimetres larger than the exposed area was placed directly upon the bone and covered by the periosteum and other tissues of the scalp. A small drainage tube was carried out from the front portion of the wound to give exit to the blood which oozed slightly from the exposed brain. Drainage tube removed on third day. Patient left hospital on tenth day. Wound healed by primary union. Pulsation distinctly perceptible over the plate.

January 8, 1899, the patient had a general convulsive seizure; another on January 13, and still another on January 27. At this time there was a bulging at the posterior part of the plate, and pressure over this area was accompanied with pain.

On February 2 the scalp was again opened. The plate had shifted a trifle towards the median line. Under the posterior por-

tion of the plate was a mass of exudate pressing the plate upward. When the plate was removed there was found to be a mass of cicatricial tissue, stretching across the entire field, attached to the skull on either side of the cavity, and adherent to the brain. This cicatricial tissue was removed with the connective tissue, which had again filled up the depression in the anterior portion of the wound, after a new celluloid plate was patterned to the shape of the cavity, but one centimetre larger. A small cut was then made in the plate on each side of the two ends somewhat in the form of a Greek cross. These cuts permitted the plate to be partly folded, and thus diminish its circumference. The plate was then placed beneath the skull rather than on top of it, as is usually done.

The newly formed connective tissue had been found extending from the margins of the bone to the brain tissue, and the cortex was intimately adherent throughout the entire circumference of the cavity to its bony margins; consequently, even from the pulsation of the meninges there must have been more or less irritation as the result of the fixation of the brain at these points by bands of connective tissue holding it fast to the edges of the bone. The more extensive and dense these adhesions become the more pronounced must have been the irritation. It was with the hope, therefore, of diminishing the area from which adhesions could extend to the cortex that the plate was introduced under, rather than above, the skull.

Of course, no surgical procedure could prevent the cicatricial tissue from again filling up the depression in the front of the wound, but the subsequent history of the case would seem to show that the introduction of the plate beneath the skull in such cases is worthy of consideration.

Subsequent History.—Eleven days after the operation the patient had fifteen convulsions in twenty-four hours. On March 4, two convulsions in twenty-four hours. On April 10, 1899, to August 20, 1900, the boy was entirely free from convulsions.

From August 20, 1900, to August 20, 1901, he had one convulsion.

From August 20, 1901, to April 4, 1902, one convulsion.

From April 4 to the present time he has had fourteen.

ON THE RESULTS OBTAINABLE BY OPERATIVE MEASURES IN AFFECTIONS OF THE STOMACH.[1]

BY JOHN B. MURPHY, M.D.,

OF CHICAGO.

On the basis of the frequency with which surgical diseases of the stomach are brought to the surgeon's notice, we may divide them into:

(*a*) Gastric Carcinoma; (*b*) Gastric Ulcer; (*c*) Pyloric Obstruction; (*d*) Pyloric Retention; (*e*) Gastroduodenal or Pyloroduodenal Lesions.

If surgery is to accomplish for the stomach all that it is capable of, the frequency with which the surgeon deals with the stomach must be for lesions in substantially the reverse order, except in the class of gastroduodenal diseases, *i.e.*, to obtain the greatest results from a prophylactic as well as therapeutic stand-point. The order of frequency with which the surgeon should be consulted must be:

(1) Pyloric Retention; (2) Pyloric Obstruction; (3) Gastric Ulcer; (4) Gastric Carcinoma; (5) Gastroduodenal Lesion.

If the first three of this second classification be timely and properly treated from a surgical stand-point, the surgeon will be consulted very much less frequently for carcinoma of the stomach. Thirty-five per cent. to 45 per cent. of all carcinomata occur in the stomach; from 1 per cent. to 3½ per cent. of all deaths are caused by this disease, varying in the hospitals in different countries,—in English hospitals, in 8468 necropsies, 1 per cent., Brinton; in Vienna, in 61,287 necropsies, 1½ per cent., Gussenbauer; in Prague, in 11,175 necropsies, 3½ per cent., Welch.

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[1] Remarks made before the Philadelphia Academy of Surgery, May, 1903.

The possibilities of surgery in carcinoma will not be materially increased by any improvements in technique over the magnificent showing of Dr. Mayo's results in 109 cases with 15.5 per cent. mortality.

The improvement in the surgery of carcinoma of the stomach must come from:

(*a*) The prophylaxis in the recognition and removal of conditions which tend to the production of carcinoma;

(*b*) Pronounced improvement in our diagnosis of the early stage of the disease;

(*c*) Early radical removal.

Before the prophylaxis can be effected, the clinician must answer a few questions. First, Are there precancerous pathologic conditions recognizable by a symptom complex? Second, What are the pathologic conditions and the symptoms? Third, How are they to be treated?

The first may be answered. They are recognized, and, as illustrated beyond controversy, may be mentioned the gastric ulcer and pyloric retentions with their sequences, cicatrices, and gastrectases;

Second, the pathologic conditions and symptoms. If we mentally review the cases of carcinoma that have presented themselves, we find that the manifestations of carcinomata have not appeared, unless in the rarest possible circumstance, as a thunder-bolt from a clear sky, but have implanted themselves on a train of gastric symptoms that have existed for months and even years. It is only fair to assume that these gastric irritations and retentions have played a prominent pathologic rôle in the production of carcinomata of the stomach, the same as the mild irritation of the pipe on the lip, the gall-stone in the gall-bladder, the impacted fæces in the colon. I refrain from speaking of the treatment of the pathologic factors here, as we will insist later that these pathologic conditions from the suffering and incapacity which they entail demand radical surgical treatment in themselves, and are up to this hour grossly neglected both by the surgeon and the physician, with few

exceptions, like in the Mayo, Mikulicz, Czerny, Mayo Robson, and Moynihan clinics.

Improvement in the medical diagnosis has been immaterial, as far as positive knowledge is concerned, in the last decade, and does not promise much for the immediate future. We have stated that carcinoma of the stomach in a large percentage of the cases is preceded by other pathologic conditions, be it ulcer, pyloric obstruction, pyloric retention with their sequences, pyloric irritation, gastrectasis, and secondary ulceration. The questions to be answered now are, "Do we recognize the transition from these precancerous conditions to the cancerous?" No. "Can we?" Yes. First, How soon after the penetration of the basement membrane by these erratic epithelial cells are symptoms manifest, and what are the symptoms? Second, How soon after the penetration of the basement membrane by these erratic epithelial cells are the cells transmitted (*a*) through the lymph spaces to adjacent areas in stomach walls, (*b*) through lymphatic drains to neighboring lymph-nodes, (*c*) through the lymphatics to the first filter gland, (*d*) from the primary filter gland to second and subsequent filter glands, (*e*) from the last filter gland to the chyle duct? How do they pass through the pulmonary capillaries? Where and how do they produce elective metastases?

Until these questions are answered, there will be little improvement in our results from a surgical stand-point with carcinoma ventriculi, as the technique of gastrectomy has well-nigh attained the ideal, as illustrated in its application to a large number of cases with magnificent results reported by Mayo and Van der Veer.

The solution of these pathologic questions herein submitted cannot come from post-mortem examinations, except in cases of accidental death occurring in the early stage of gastric carcinoma. They must be determined on the surgical table (*a*) in operations for the pathologic conditions which lead to carcinoma and (*b*) in explorations for suspected carcinoma by celiotomy and gastrotomy.

The results of the mechanical surgical treatment of pyloric obstructions and retentions are gratifying, first, as to the relief afforded the patients, and, second, as to their freedom from danger. The former is well recognized; the latter, the freedom from danger, is represented in Mayo Robson's results (reported to me in a personal communication, February 9, 1903) in 101 cases of posterior gastro-enterostomy with 3.9 per cent. mortality, and twenty cases of pyloroplasty without a single mortality. A study of the mortality shows that the deaths were due primarily to the extremely low condition of the patient at the time of operation. With these facts in view, it is fair to presume that the physician will call on the surgeon more frequently for exploratory laparotomy for diagnostic purposes; furthermore, that the surgeon will not only perform exploratory laparotomy for the diagnosis of gastric lesions, but that he will do as a routine the rational operation, which is the large longitudinal gastrotomy, and make an inspection of the gastric mucosa, which is so necessary for the recognition of the early carcinomatous changes. That this operation is practically without danger will be accepted from the great number of more difficult operations which have been performed with their *nil* mortality from the operation *per se*. Exploratory gastrotomy, therefore, will be the ideal procedure for the early diagnosis of suspected gastric carcinoma. By this procedure many lives will be saved, much suffering avoided, and the operation for gastric carcinoma will give entirely different results in their immediate mortality, and the permanency of the cure. The time and frequency of transmission of carcinoma from the original focus of invasion to the neighboring lymphatics and glands depend upon the portion of the stomach primarily attacked. They are at a minimum in the greater curvature and reach the maximum in the lesser curvature and pyloric area. This is in direct ratio to the richness of the lymphatic supply, and is analogous to the same pathologic predisposition in the gall-bladder, uterus, and urinary bladder. Unfortunately for the patients, however, the areas of least likelihood of transmission are also the areas of

least primary invasion. Fortunately for the surgeon, the area most frequently attacked by carcinoma is the one most easily exposed for ocular examination in exploratory gastrotomy.

Do the results of operations for carcinoma ventriculi so far obtained justify us in hoping for much better results in the future? Yes; on the following basis, supported by the statistics herewith submitted. First, There is a small percentage of unquestioned permanent cures already secured, notwithstanding delayed or tardy diagnoses. Second, Life has been materially prolonged in the cases in which the operation was not performed *in extremis*. Third, The suffering of those who survived the operations of radical removal was materially less, as death was caused by the metastatic growths rather than by the recurrence of the disease *in loco*. Fourth, The price in mortality is not too great for the profit in longevity and freedom from suffering. Fifth, The future will give more fruitful results, with ever increasing early recognition of the disease and our greatly improved technique. That the number of permanent cures will increase may be estimated from the accessibility of the primary location of the disease, as shown in 1300 cases reported in Mikulicz's article. It was in the pylorus, 791 times, 60.8 per cent.; lesser curvature, 148, 11.4 per cent.; cardia, 104, 8 per cent.; posterior wall, 68, 4.7 per cent.; very late cases (whole or part of stomach), 61, 4.6 per cent. Multiple tumors occurred with pylorus as primary focus in forty-five cases, 3.5 per cent.

With greater curvature, thirty-four cases, 2.6 per cent.; anterior wall, thirty cases, 2.3 per cent.; fundus, nineteen cases, 1.5 per cent.

Illustrating the frequency of location reported by individual operators, we quote the following:

Location in pylorus, 60 per cent.; fundus, 30 per cent.; cardia, 10 per cent. (Gussenbauer).

Location in pylorus, 54 per cent.; lesser curve, 16 per cent.; cardia, 9 per cent.; anterior wall, 3 per cent.; posterior wall, 4 per cent.; both walls, 4 per cent.; greater curve, 4 per cent.; diffuse, 6 per cent. (Lebert).

Location in 1796 cases: pylorus, 1110; lesser curve, 197; cardia, 158; rest of stomach, 331 (Furnivall).

Age. Seventy-five per cent. between forty and seventy years (Welch).

Age. Any period of adult life; most common forty to sixty years (Mayo Robson, 1903).

Sex. Thirty-six males to twenty-three females.

Metastases. In 59 per cent. (Gussenbauer and Winiwarter).

The frequency of prominent symptoms: In 86.6 per cent. of cases pain is present; in 85.3 per cent. of cases vomiting is present; in 76.6 per cent. of cases tumor is present (Robson, 1903).

Mikulicz, in writing on cancer of stomach, states: Results are unsatisfactory because (1) patients do not seek advice soon enough, but (2) mainly because a sufficiently radical operation is not done. To be radical, the resection must extend up the duodenum five to ten millimetres.

In papillary cancer with a large base, the prognosis is relatively good, as it is least malignant. Since the radical operation takes some time, Schleich's anæsthesia is recommended, which even debilitated patients can stand.

Mikulicz claims that in most cases anastomosis between the duodenum and the stump of the stomach is impossible. Hence he generally closes the duodenum by a purse-string suture and establishes an anastomosis between the inferior angle of the gastric wound and the jejunum. This is simpler, takes less time, and is more rational, since it changes the position of the stomach the least.

Indications for operations in gastric cancer, as given by Mayo Robson (April 25, 1903, *British Medical Journal*):

(1) In irremovable growth at the cardiac end, if it involve the cardiac end and adjacent portion, gastrostomy should be performed in order that starvation may be staved off.

(2) Where the disease involves a great part or the whole of the stomach, is irremovable, and gastro-enterostomy impracticable, and in which any attempt at taking food brings on

pain and vomiting, so that the patient must rapidly die in great distress, here a jejunostomy should be performed, and through a Jaques catheter sufficient food can be given to ward off starvation, and relieve the pain caused by attempts at taking food by the mouth. The operation can be done through the small exploratory incision, and need involve very little longer time.

(3) If the disease produces pyloric obstruction, but where, on account of extreme feebleness, or because of extensive adhesions, secondary growths of involvement of glands, it is considered unwise to attempt pylorectomy or partial gastrectomy, a gastro-enterostomy may be performed.

He concluded as follows: 1. How desirable it is to make an early diagnosis of cancer of the stomach in order that a radical operation may be performed at the earliest possible moment.

2. That it may be needful to perform an exploratory operation in order to complete or confirm the diagnosis.

3. That such exploration may be done with little or no risk in the early stages of the disease.

4. That even where the disease is more advanced and a tumor perceptible, an exploratory operation is, as a rule, still advisable in order to carry out radical or palliative treatment.

5. That where the disease is too extensive for any radical operation to be done, the palliative operation of gastro-enterostomy, which can be done with very small risk, may considerably prolong life and make the remainder of it much more comfortable and happy.

6. That some cases, thought at the time to be cancer, too extensive for removal, may, after gastro-enterostomy, clear up completely and get quite well.

7. That in cases of disease of the cardiac end of the stomach too extensive for removal, the operation of gastro-enterostomy may considerably prolong life and prove of great comfort to the patient by preventing death by starvation.

8. That even where the disease is too extensive either for removal or for a gastro-enterostomy being performed with a

fair chance of success, the operation of jejunostomy may occasionally prove of service to the patient.

9. That where a radical operation can be performed, the thorough removal of the disease may bring about as much relief to the patient as does the operation for the removal of cancer in the breast, uterus, and other organs of the body, and that in some cases a complete cure may follow.

A great improvement in the permanent results can be obtained by recognizing and taking advantage of the "area of immunity from cancer," demonstrated by Mayo. Here we note that, with the exception of 17.4 per cent. of the cases (viz., those occurring in the cardia, 8 per cent.; in the posterior wall, 4.7 per cent.; involving the whole stomach, 4.7 per cent.), cancer involves the pyloric area. This "immune area" can be preserved in gastrectomy, and furthermore all but that portion can be safely removed, permitting the surgeon to go wide of the primary focus, thus diminishing the liability of recurrence *in loco* or in the adjacent glands.

It seems to me, however, that the surgeon has a still greater field, which up to the present time has been grossly neglected, viz., *the prophylaxis of carcinoma of the stomach.* That carcinoma of the stomach can be prevented by the removal or cure of the conditions which lead to its production, it seems to me, is a perfectly justifiable conclusion, from our present knowledge of the pathologic conditions which precede and predispose to produce carcinoma of the stomach.

As shown by the epoch-making article of Professor Von Mikulicz, "Die chirurgische Behandlung des chronischen Magengeschwürs." (*Mittheilungen aus den Grenzgebieten der Medicin und der Chirurgie*). It is estimated that on an average 4 per cent. to 5 per cent. of the race suffer from gastric ulcer, and one-fifth die as a result of these gastric ulcerations. Friedler found in 2200 post-mortems that in 20 per cent. of the women and 1½ per cent. of the men fresh or cicatrized gastric ulcers were present. These ulcers and scars were frequently the seat of carcinomatous degeneration; their proper treatment is, therefore, an important factor in the prophylaxis of carcinoma.

That carcinoma is induced or invoked by mild and repeated sub-inflammatory irritations of normal or cicatrical epithelial surfaces is an accepted fact. The other conditions which tend to carcinoma of the stomach are those which prevent the normal emptying of the viscus, as the retention conditions of the pylorus.

The prophylactic treatment of carcinoma, therefore, involves the early relief and removal of all the conditions which tend to this retention and its sequential gastric irritation. The surgery of these conditions, in the following order, should most concern us at the present time.

The radical removal of the pylorus, even for non-malignant disease, cannot be considered, except for complete occlusions, as it involves a mortality not to be overlooked. However, the relief of the obstructive conditions can be overcome by a safe and very satisfactory operation,—gastro-enterostomy. The results in malignant and non-malignant cases may be gleaned from the following statistics:

GASTRO-ENTEROSTOMY.

Author.	Year.	Disease.	Cases.	Recovery.	Deaths.	Mortality. Per cent.
Robson	1900	.....	1978	...	...	36.4
	(This series of 1978 evidently has many duplicates, as it is made by adding up several series of cases.)					
Mayo Brothers	1902	Cancer, etc.	107	97	10	9.0
Chlumsky in cases of Mikulicz	1881–5	Cancer, etc.	35	12	23	65.71
	1886–90	Cancer, etc.	114	61	53	46.47
	1891–6	Cancer, etc.	401	265	136	33.91
To June,	1897	.....	...	...	24	32.5
Czerny	1897	.....	53	(All with Murphy button)	...	24.5
Keen	1898	.....	7	3	4	57.1
Hochenegg	1897	Cicatrices	3	3	...	0.0
	1897	Cancer	3	2	1	33.0
Ewald's Clinic	1894–7	.....	25	9	16	64.0
	1898	.....	11	...	...	64.7
Kappeler	1887–98	31 Cancer, 8 Ulcer, etc.	39	27	12	30.76
Carle and Fantino	1901	24 Cancer	24	15	9	37.5
	1901	27 Stricture	27	...	1	3.8

Author.	Year.	Disease.	Cases.	Recovery.	Deaths.	Mortality. Per cent.
	Carle and Fantino's mortality of 3.8 per cent., so much referred to, is for *stricture* only.					
Korte and Herzfeld	1902	Anterior Method	10	7	3	30.0
	1902	Posterior Method	20	16	4	20.0
Eiselsberg	1897–1900	.....	37	32	5	13.5
Terrier	1902	Cancer and Ulcer	22	21	1	4.54
Kronlein	1902	Cancer	74	...	...	24.3
Murphy	1903	Cancer, Ulcer, etc.	18	15	3	16.6
Hartmann (Paris).	1900	.....	40	32	8	20.0

PERSONAL CASES.

Males, 13. Females, 6. Average age, 41.7 years.

	Males.	Females.	
Pyloric Obstruction	2	2	..
Carcinoma Pylorus	2	..	1 death.
Carcinoma Stomach	4	1	1 death.
Ulcer Stomach	3	1	1 death (continued hæmorrhage).
Dilatation of Stomach	1	1	..
Gastroptosis	1	..	..
Vicious Circle	..	1	..
	13	6	3

Anterior Method	4
Posterior Method	13
Posterior with Entero-enterostomy	1
	18

Average time of passing button, sixteen days.

COMPARISON OF ANTERIOR AND POSTERIOR METHODS.

	Anterior.		Posterior.	
	Cases.	Mortality. Per cent.	Cases.	Mortality. Per cent.
Chlumsky	231	38.09	152	35.52
Mayo (W. J. and C. H.)	83	....	24	.....
	(Results equally good.)			
Kappeler	8	60.0	10	33.0
Carle and Fantino	12	33.0	10	40.0
Korte and Herzfeld	10	33.0	20	40.0
Terrier	..	....	22	4.54

The operative technique was as follows:

Mayo Brothers. Button, either anterior or posterior.

Czerny. Button, posterior.

Kocher. Suture, posterior.

Mikulicz (benign). Suture, anterior.

Mikulicz (malign). Button, anterior.

Carle and Fantino. Posterior only.

Terrier. Posterior only.

Jacobson ("Text-Book of Operative Surgery"). Halsted's method of suture best. Posterior gastro-enterostomy with the button gives as good results as any other method.

Mayo Robson has used the following successfully: (1) Simple suture, (2) Senn's plates, (3) Robson's bobbin, (4) Murphy button. Prefers No. 3.

Keen. In benign cases, slight difference between anterior and posterior methods. In cancer, posterior more desirable. In non-malignant cases, gastro-enterostomy preferable to pyloroplasty.

Monprofit (France) uses the anterior method only when the posterior is contraindicated by the anatomic conditions. The functional results are much more defective than in the posterior or in Y. As between the posterior method and that in Y, the functions are about the same. As Roux's operation (in Y) is more difficult and takes longer, he uses the posterior method in cachectic patients. Silk sutures always; no mechanical devices.

Kappeler resects stomach, if possible, instead of performing gastro-enterostomy.

Hochenegg prefers posterior method, which avoids compression of the colon and kinking of the small intestine.

Gastro-enterostomy may be done as a preliminary operation, as advised by Quénu and Lauenstein. The patient gains in strength, and the tumor, no longer irritated, may decrease in size; so later pylorectomy may be undertaken.

Eiselsberg (1901) in a woman of thirty-four made the following operations in succession: Jejunostomy, gastrotomy, jejunorrhaphy, posterior gastro-enterostomy, and, lastly, gastrorrhaphy. Recovery.

Influence of Gastro-Enterostomy on Gastric Function.—Kovesi. Man of fifty-six years, with lead poisoning, and

symptoms of gastric trouble for eight months. Pyloric cicatrix found. Repeated examinations of gastric juice after operation showed acidity and decreased proportion of hydrochloric acid much lessened. Amylolysis increased; saccharification more complete. The organ, however, remained dilated, and its motor power was but slightly increased. Our personal experience in this non-malignant case was most gratifying, and the operation will be performed with increasing frequency and, I am sure, with great benefit to the patients; in malignant cases it promises but little.

The removal of the pylorus in fibrous stricture or in complete cicatrical closure gives most gratifying results, considering the condition. The general results of pylorectomy for all conditions may be estimated from the following statistics:

PYLORECTOMY.

Author.	Year.	Disease.	Cases.	Recovery.	Deaths.	Mortality. Per cent.
Robson	1900	Cancer, etc.	572	398	174	30.4
Von Hacker-Billroth	1885	Cancer, etc.	18	8	10	55.0
Winslow	1885	Cancer, etc.	59	17	42	71.0
Rydygier	1885	Cancer, etc.	48	17	31	64.0
Jonnesco	1892	Cancer, etc.	130	46	84	65.0
Wölfler	1888–96	Cancer, etc.	219	...	...	31.2
Hahn	1898	Cancer, etc.	28	18	10	35.6
Gussenbauer	1898	Cancer, etc.	13	9	4	35.7
Von Hacker	1898	Cancer, etc.	9	8	1	11.1
Eiselsberg	1897–1900	Cancer, etc.	8	7	1	12.5
Ewald	1894–97	Cancer, etc.	12	3	9	75.0
	1898	Cancer, etc.	6	...	...	62.0
Carle and Fantino	1901	Cancer, etc.	...	...	...	20.0
Hartmann (Paris)	1900	Cancer, etc.	20	15	5	25.0
Brauer	1885	Cancer, etc.	72	17	55	76.0
Kocher	1898	Cancer, etc.	57	52	5	8.78
Maydl	1899	Cancer, etc.	25	21	4	16.0
Rydygier	1901	Cancer, etc.	25	8	17	66.0
Czerny	1881–98	Cancer, etc.	29	18	11	39.0
Morison	1901	Cancer, etc.	16	9	7	45.0
Kronlein and Schlatter	1881–88	Cancer, etc.	4	1	3	75.0
	1888–98	Cancer, etc.	20	18	2	10.0
(Included is Schlatter's total gastrectomy.)						
Murphy	1903	Cancer, etc.	14	10	4	28.6

KOCHER'S METHOD.

		Cases.	Recovery.	Deaths.	Mortality. Per cent.
Kronlein		19	9	10	....
Czerny		21	13	8	....
Kocher	To 1894	25	21	4	28.6
	since	10	9	1	....
Watten		2	1	1 (pneumonia).	

PERSONAL CASES.

Males, 11. Females, 3. Average age, 40.5 years.

	Males.	Females.	
Carcinoma Pylorus	3	1	2 deaths.
Carcinoma Stomach	1	..	1 death.
Ulcer Stomach	2	..	..
Ulcer Stomach (Perforating)	2	1	1 death.
Pyloric Obstruction	3	..	..
Gastroptosis	..	1	..
	11	3	4

The results in complete gastrectomies are as follows:

1. Conner (Cincinnati); patient died on table.
2. Schlatter (Zurich); lived eleven months.
3. Brigham (San Francisco); alive two years after.
4. Delatour (Brooklyn); alive seventeen months after.
5. Richardson (Boston); died at eleven months.
6. McDonald (Albany); alive eighteen months after.
7. Chavasse (Birmingham); died.
8. Noble (Philadelphia); died on table.
9. Bernays (St. Louis); died thirty-six hours after.
10. Ricord (France); stomach, first part of duodenum, part of pancreas, alive eleven months after.
11. Boeckel; too recent.
12. Harvie; too recent.
13. Dr. Carvalho (Brazil); reported ten days after, alive.

These results are not discouraging, considering the extent of tissue involved at the time of operation.

Effect of Adhesions.—Of 542 cases of carcinoma of the pylorus, in 370 adhesions were present (Gussenbauer and Winiwarter).

If adhesions are extensive, 72.5 per cent. mortality.

If no adhesions, 27.2 per cent. mortality (Haberkant).

Two cases, no adhesions; two recoveries.

Seven cases, slight adhesions; four recoveries; three deaths.

Five cases, extensive adhesions; no recovery; five deaths (Von Hacker and Billroth).

The changes in technique practised by Mr. Moynihan (Leeds) may give better immediate and permanent results. The plan is based on good anatomic lines, and careful consideration has been given the routes of distribution of the cells in the lymph spaces and lymphatic drainage tracts and filter glands.

The results of the various operative techniques may be judged from the following statistics:

Pylorectomy with end-to-end anastomosis, 148 cases; 56 deaths; 37.8 per cent.

Pylorectomy with terminal and lateral anastomosis, 64 cases; 10 deaths; 15.6 per cent.

Pylorectomy with lateral anastomosis, 54 cases; 24 deaths; 44.4 per cent.

Pylorectomy by invagination, 4 cases; 4 deaths; 100 per cent.

Pylorectomy by two stages, 3 cases; 0 deaths; 0 per cent.

Rydygier resects a large portion, two to four inches beyond the apparent limits of the growth.

Hochenegg uses no lavage, thinks it is insufficient, and fatigues the patients. He uses Kocher's method only; believes pylorectomy is always indicated when the tumor is not too adherent, when there are no metastases in the peritoneum or the great omentum, and the patient's condition allows it. Extent of the growth is no contraindication, for Maydl resected three-fourths of the stomach, with a survival of seven years. Nor is adhesion to the pancreas a contraindication any longer.

Hartmann (of Paris). Half of his patients were living at the time of report. He attributes this to a special technique, removing the lesser curvature and the glands along the right

branch of the coronary artery, as follows: The stomach is pulled forward, the right branch of coronary is ligated, elastic forceps are then placed protecting the greater tuberosity and the cardia. The pylorus is thrown back on the right lip of the incision, and the gastroduodenalis is found at the bottom of the pancreaticoduodenal groove and ligated. The diseased mass is then removed.

Kocher. If many adhesions exist, circular resection is less dangerous than excision of ulcer. In suspected cancer, when in doubt, operate. Advocates resection of pylorus with absolute closure of wound, then make a posterior gastro-enterostomy.

"If we do not prolong life by a single day, the operation is still justified, in my eyes." (Mikulicz.)

Rydygier (*Revue de Chirurgie Abdominale*, 1901) gives details of a case of pylorectomy in a woman of forty-nine, operated on nineteen years before for ulcer penetrating the pancreas, a part of which was excised. By removing a conical segment of the posterior wall of the duodenum, direct suture of the stomach and duodenum was possible without folds. The patient's digestion is very good, and she works hard. Five accouchements since operation.

The rapid gains in weight and the complete restoration in health in the non-malignant pylorectomies make one think seriously of pylorectomy in place of pyloroplasty, at least, as it has been performed. The permanent results of pyloroplasty have been anything but gratifying. If pyloroplasty is to become one of the standard operations, it must be so performed that no adhesion or fixation of the pylorus to the anterior abdominal wall follows it as a second pathologic condition.

The results of stomach operations in general are seen in the following statistics:

Guinard, of Paris (*Revue de Gynécologie*, 1896). Mortality has been steadily lessening, as shown by the following collected cases:

Author.	Year.	Cases Corrected.	Recovered.	Died.	Mortality. Per cent.
Hahn	1883	27	4	23	85.18
Kramer	1885	72	17	55	69.9
McArdle	1887	62	27	35	56.4
Guinard	1891	149	63	86	57.71
Zeller	1892	117	54	62	53.0
Haberkant	1894	207	114	93	54.4
Wölfler, 1896, experience of fifteen German surgeons:					
		92 cases before 1888			56.4
		173 cases, 1888–96			31.2

In 75 cases, Mikulicz found 29 inoperable; in 17 more, exploratory incision being made, they were found inoperable also; in 21 gastro-enterostomy was done; in 8, resection.

Doyen has made 146 operations for stomach diseases, with 22 deaths. In 66 cases of carcinoma, 20 died. Prefers Roux's method (gastro-enterostomy in Y).

Stendel. Stomach operations, Czerny's Clinic. Up to the end of 1897, 192 operations were performed (not including gastrostomies), with an average mortality of 29 per cent.

Years.	Pylorectomies.	Gastro-Enterostomies.	Pyloroplasties.	Exploratory Laparotomies.	Other Operations on Stomach.	Total.	Mortality. Per cent.
1881–89	13	14	0	11	4	49	4.5
1890–93	7	17	3	5	2	34	18.0
1894–95	2	23	7	8	4	44	27.0
1896	4	28	1	2	0	35	34.0
1897	3	28	0	4	2	37	16.0
1881–97	29	110	11	30	12	199	29.0

In feeble subjects, Czerny has tried to divide the operation into two stages,—gastro-enterostomy and then pylorectomy. Patients, however, nearly always refused to submit to the latter until too late.

No pyloroplasties since 1896 on account of bad results.

Since June, 1896, sutures have been abandoned in favor of the Murphy button. In 53 gastro-enterostomies with the button, the mortality was 24.5 per cent. In gastro-enterostomy with suture it was 36.8 per cent.

Stomach Operations.—CHLUMSKY. (Mikulicz's Clinic.) June, 1897–August, 1898. Seventy-eight gastro-enterostomies; 21 died in first 30 days (26.92 per cent.).

1884–1899. One hundred and fifty-five gastric operations; 45 died in first 30 days (29.60 per cent.). One hundred and fifteen malignant growths; 40 died (34.78 per cent.). Thirty-four ulcers; benign strictures; 2 died (5.87 per cent.). First 4 per cent. by Wölfler's method.

" 1891–1896. Von Hacker's method alone used. In all 13 per cent. by Wölfler's method, 5 deaths. Forty-three per cent. by Von Hacker's method, 14 deaths.

INTESTINAL OBSTRUCTION FOLLOWING OPERATION FOR REDUCIBLE LEFT INGUINAL HERNIA DUE TO A LOOP OF SMALL INTESTINE CAUGHT IN TREITZ'S FOSSA.[1]

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THE observation which I am about to report is the first which I have observed after operations for inguinal hernia. In a study of 459 cases of hernia (inguinal, 405; ventral, 24; femoral, 30) made in January, 1899 (*The Johns Hopkins Hospital Reports,* Vol. vii), we observed but a single case which exhibited symptoms of intestinal obstruction (*Ibid.,* p. 233). In this instance the symptoms developed forty-eight hours after operation, but were entirely relieved in a few hours by high enemata. This patient has been observed up to the present writing, seven years after operation. In the study of the ultimate results after operation for inguinal hernia (also of femoral and umbilical) not a single patient has presented symptoms of intestinal obstruction. Dr. Follis, the resident surgeon of the Johns Hopkins Hospital, has recently (July, 1903) gone over the histories of all the operations for hernia since the publication of my paper, and finds not a single instance of post-operative intestinal obstruction. The number of herniotomies which have been performed in Professor Halsted's clinic up to the present time is over 900. This observation includes all cases of hernia of all varieties, reducible or irreducible, in which the intestine has not been gangrenous. As a matter of fact, in the cases of gangrenous hernia which have recovered from the first operation there has been but one case

[1] Reported in brief before the Meeting of the American Surgical Association, May, 1903.

of acute intestinal obstruction, and in this instance the patient did not recover.

The immunity to intestinal obstruction is rather remarkable in view of the great possibilities of adhesions of the bowel or omentum to the sutured neck of the sac.

CLINICAL HISTORY IN DETAIL.

The patient was a physician about fifty years of age. He had observed a left inguinal hernia for a number of years. It had always been reducible. A truss had been worn with comfort.

Operation, May 11, 1901.—The usual dissection was made under cocaine infiltration anæsthesia. After dividing the aponeurosis of the external oblique muscle, separating and dislocating upward the internal oblique muscle and dividing the infundibuliform fascia, it was demonstrated that the left inguinal hernia was of the direct variety. The sac was not situated with the cord in the infundibuliform fascia, but protruded between the deep epigastric vessels and the conjoined tendon. The opening was large. About the neck of the sac there was a rim of connective tissue, and the deep epigastric vessels were apparently situated in this new connective tissue. Manipulation and dissection at this stage of the operation were very painful, and it was impossible to infiltrate properly with the cocaine solution. The patient became restless, and I feared perhaps that I might inadvertently injure the epigastric vessels in my attempt to isolate and excise the sac. For this reason the patient was completely narcotized with chloroform. The operation was then completed in the usual manner. There were no adhesions between omentum, intestine, and sac.

During the next twenty-four hours nausea and vomiting were present to an unusual degree, and during the act of vomiting, the patient, who was a very muscular man, contracted his abdominal muscles to such an extent that I feared the sutures might pull out. (The wound had been closed with silver wire.) During the next twenty-four hours the nausea and vomiting continued, and the vomitus changed from bile-stained fluid to one which had the color and odor of the contents of the upper portion of the small intestine.

I saw the patient again forty-eight hours after operation. His general condition was excellent. He was restless and complained of discomfort due to abdominal distention. At intervals of about one-half to one hour he would vomit. He complained of no definite area of pain, but of general abdominal discomfort. On examining the abdomen, the distention was not symmetrical, but occupied the upper abdominal zone, and was most marked in the right upper abdominal quadrant. At my first examination the area of liver-dulness extended to the costal margin; within the next six hours percussion revealed an ascending tympanitic zone, which finally reached a line about three centimetres above the costal margin. Leucocytes, when first observed, were 12,000; during the next six hours they rose slowly to 16,000. The wound to all appearances had remained as sutured. During the previous day and during my observation, high rectal enemata brought away some gas and liquid fæcal matter.

This clinical picture impressed me as an unusual one. I had never observed in a healthy man, after laparotomy and narcosis, such persistent vomiting, nor a vomitus of a distinctly fæcal character. The asymmetry of the abdominal distention was suggestive. Compared with my other observations on leucocytosis after an uncomplicated laparotomy, the count in this case was higher, and the number of leucocytes was rising instead of falling. The leucocyte count corresponded exactly to a case of intestinal obstruction due to adhesions observed three months after an operation for appendicitis. The distinct and progressive diminution in the area of liver-dulness was another important clinical sign. In view of these facts, after watching the patient about six hours, I felt that further delay was not justifiable.

Second Operation, about Fifty-six Hours after the First Operation.—Chloroform narcosis. The incision was made along the outer border of the left rectus muscle. On opening the peritoneum, the omentum was exposed; there were no adhesions and no fluid. The gloved hand was then introduced to the position of the wound in the lower left abdominal zone; there were no adhesions to the sutured neck of the hernial sac. The loops of small intestine first exposed were apparently normal; then we encountered a number of loops of slightly distended intestine, apparently of the jejunum and upper portion of the ileum; then I withdrew a loop of the ileum which showed a definite constricting ring of about three centimetres in circumference. On one

side of this constriction the small intestine was distended, on the other side almost collapsed. Near the constriction there were a few areas of ecchymosis, but no exudate of fibrin. In a few moments the depression in this loop of intestine corrected itself, and gas from the distended loop passed into the collapsed loop. In view of the position and character of the constricted intestine, I felt that one was justified in considering that this loop of intestine had been pushed into the fossa duodenojejunalis (the so-called Treitz's fossa) during one of the acts of extreme retching which I have already noted as taking place after the first operation. During the withdrawal of the loops of the intestine, this constricted loop had undoubtedly been displaced. After demonstrating this positive intestinal obstruction, the laparotomy wound was closed.

In the convalescence from this second operation the patient quickly recovered from the usual nausea and vomiting, the bowels moved in twenty-four hours. Both abdominal wounds healed without complication. However, the patient was much depressed, and the convalescence to full strength was slow; it was at least six months before he felt able to take up his full duties. At the present writing (July, 1903), two years and two months since operation, the patient is in perfect health. There have been no abdominal symptoms, and both wounds are solid.

It is possible, but not probable, that this obstruction might have relieved itself; but I am convinced that the symptoms in this case justified the operation at a period in the clinical picture when the symptoms of intestinal obstruction were but suggestive and not positive. The observation has aided me greatly in recognizing intestinal obstruction at an earlier period in disease, at a period in which operative interference gives the best results.

Probably one of the most important early signs of intestinal obstruction is a rise in the leucocyte count. I referred to this fact first in 1898 (*The Johns Hopkins Hospital Reports*, Vol. vii, p. 332), and again in a paper read before the American Surgical Association in 1901 (*Transactions of the American Surgical Association*, Vol. xix, 1901, p. 139). In all of our observations of postoperative obstruction as well as primary intestinal obstruction, there has been leucocytosis,

varying from 15,000 to 30,000. In the majority of instances the leucocyte count is from 15,000 to 20,000; higher counts, 25,000 to 35,000, are usually associated with early gangrene or peritonitis. Later in the disease, when the patient is moribund from gangrene, peritonitis, or autoinfection, the leucocyte count falls. The value of the leucocyte count is therefore of the most importance in the early hours. In one of my observations it was the only positive sign (*Ibid.*, p. 140). The patient had previously been operated on in the hospital for acute appendicitis with abscess, and the wound had been drained. The clinical history, of course, pointed to the possibility of obstruction from adhesions. Some four months after this operation he came to the hospital complaining of abdominal pain of six hours' duration in the region of the scar. There had been no nausea or vomiting, and the abdominal examination was negative. The pain, however, was quite severe and was slightly remittent, as if coincident with peristaltic action, although such intestinal movements could not be made out during a long and careful examination. The leucocyte count in four hours rose from 8000 to 12,000. There was no fever, and the patient had not taken any food.

In view of the history and the rise of the leucocytes, an exploratory operation was done. It was found that the omentum and cæcum were adherent to the old wound, and to the cæcum was an adherent knuckle of small intestine, producing a partial obstruction. The ileum from this point of obstruction for a distance of one foot was collapsed; in the other direction slightly distended. The operation required some time in order to separate all the adhesions; and it was fortunate that an early exploration was done, when the patient was in such a good condition that prolonged anæsthesia was not contraindicated.

The early recognition of postoperative intestinal obstruction is one of the greatest importance, because in the majority of instances the patient should recover if the operative interference is performed in time. Following general narcosis, and in some instances local anæsthesia, and especially after laparotomy, nausea and vomiting, obstipation and abdominal

distention are not uncommon symptoms. If these symptoms occur after the third day, they are very suggestive of obstruction; but when observed within the first three days after operation, the period of onset is of no aid in the differential diagnosis. Not infrequently these symptoms are marked, and it often requires hours before the usual therapeutic measures are followed by the passage of fæces and gas and the relief of the symptoms. It is in these cases that we must seek for early signs that will differentiate what we might call the pseudo-postoperative intestinal obstruction (probably due to intestinal paresis) from true postoperative intestinal obstruction. The former is always relieved after the usual therapeutic measures, although in many instances it requires a number of hours, rarely a day or two. In the cases of the severe type, the patient becomes very much depressed, and now and then critically ill. If the symptoms are due to true obstruction, delay is dangerous; the depression from autointoxication in true obstruction is always greater than in false obstruction; gangrene and peritonitis frequently are rapid secondary pathologic conditions. To save our patient suffering with true obstruction, we must operate early. The therapeutic means of value in false obstruction are harmful in true obstruction. As far as my experience goes, the most accurate early sign is the leucocyte count. After an ordinary laparotomy for a non-septic pathological lesion, the postoperative leucocytosis is rarely above 12,000 or 15,000, usually about 10,000. This we have found to be true in the postoperative leucocyte counts after operations for hernia and appendicitis between attacks. Unfortunately, not many counts have been made, but so far we have found no leucocytosis. In only a few instances have we leucocyte counts in cases of severe abdominal distention following laparotomy. In those which recovered without operation, we have observed a leucocyte count no higher than 15,000. In other cases in which the clinical picture was about the same, and in which we have observed a leucocytosis varying from 15,000 to 30,000, an operation has been performed, and obstruction found and relieved.

These cases will be reported in detail later.

PERFORATING GUNSHOT WOUND OF THE CERVICAL PORTION OF THE SPINAL CORD.

REPORT OF A CASE IN WHICH RECOVERY WAS SECURED, WITH ABILITY TO WALK.

BY LEWIS S. PILCHER, M.D.,

AND

B. ONUF, M.D.,

OF NEW YORK.

On the evening of July 16, 1901, a boy, eleven years of age, while handling a 22-caliber rifle, accidentally discharged it. The bullet entered his body in front in the middle line, just below the level of the episternal notch, and ranged upward and backward. He fell at once helpless and in profound shock. He was seen by Dr. Pilcher four hours later at the request of his physicians, Drs. Denton and Hammond, of Freeport, Long Island. He was then paralyzed both as to motion and sensation from the clavicles down. He had reacted from the first shock of the injury. He presented no signs of injury to trachea, œsophagus, recurrent laryngeal nerves, or any of the great vessels at the base of the neck. He had urinated and defecated involuntarily, and was the subject of priapism. His respiration was entirely abdominal, owing to the paralysis of the intercostals.

The following morning he was brought to the city and placed in the Methodist Episcopal Hospital.

Upon admission his condition was as stated. He lay with forearms flexed and pronated, without any voluntary control, but at frequent intervals spasmodic, involuntary muscular twitchings would occur. The superficial skin sensation, tested by needle pricks, was normal in face, shoulders, and neck to the level of the wound; also over the surface of the right arm and forearm, and over the left, except over the extensor surface of the left forearm, where it was absent. Below the level of the wound there was loss of all sensation in chest, back, abdomen, thighs, legs, and feet. In pricking the sole of the left foot on its inner aspect, a contraction of the leg at the knee took place, and the

toes flexed. This occurred on the right foot, also, to some degree, but not so well marked.

To faradism, the flexors responded promptly on both sides, the extensors hardly at all. No response was elicited from the abdominal muscles, nor of the thigh, excepting when one pole was placed on the inner aspect of the thigh about six inches above the patella, and the other below at a point about two inches from the patella, when a contraction would occur and the patella be drawn up. No other muscles of leg or foot gave any response. Some œdema of both lungs was present.

For the first ten days after admission to the hospital, the tendency to pulmonary œdema and hypostatic pneumonia required constant attention to keep it in check. Frequent dry cuppings and strychnine were the chief agents employed.

During this same period the involuntary defecation and urination continued, but at the end of this period he regained control over his sphincter ani. This was synchronous with a notable improvement in his condition as a whole. The lack of control over the sphincter vesicæ persisted for some time longer, but gradually improved also, until at the end of three weeks he had sufficient control over it so that he could give warning and secure a urinal to receive the contents of the bladder, but he could not retain any large amount of urine in his bladder. He ultimately regained normal control over his bladder.

Meanwhile, on July 21, the fifth day after the accident, he first moved the toes of the left foot voluntarily. A gradual improvement in control of the muscles of the left side progressed thereafter until, in the fourth week, it was noted that he could move his left limbs nearly normally, and that he had a very good grip with his left hand. To a less degree an improvement in the right side had taken place. On August 2, seventeen days after the injury, he began to move his right leg, and at the end of another week, the fourth week already mentioned, he could flex the right leg on the thigh, but the movements were very weak.

The fact that he had improved to the extent which has been noted, led to the thought that possibly, instead of an absolute transverse lesion of the cord or penetration of the cord, there may have been sustained a severe contusion of the cord, with more or less extensive hæmatoma; and that possibly there might

be still present projecting spiculæ of bone, which might have been caused by the bullet penetrating the bony walls of the vertebral canal. It was also possible that the local conditions, whatever they were, might be aggravated, and would be prolonged by the presence of the bullet if, lodged in the wall of the canal, it projected into the vertebral canal. An anteroposterior skiagram showed the bullet lodged in the midline between the fifth and sixth cervical vertebræ. (Fig. 1.)

Efforts to more exactly localize the position of the ball by taking skiagrams from the side of the neck were unsuccessful at that time upon our part. They were repeatedly made, but our technique was defective, or the plates were imperfect, or the machine itself did not work satisfactorily. Whatever the cause may be, none of the attempts at securing a lateral view were successful, and we were compelled to proceed with our treatment of the case without the help which that might have afforded us.

In view of the nature of the lesion and possible help which might come from laying bare the part, and the removal of whatever condition might be present that should be aggravating it, it seemed to us proper that an exploratory operation should be done. Accordingly, on August 12, under chloroform, an incision was made over the tip of the spine from the third cervical to the seventh cervical vertebra carried down to the laminæ on the right side. It will have been noted from the history of the case that the extent of loss of power was much more marked on the right side than on the left, hence it seemed probable, in our speculations as to the conditions that were present, that we should find the greatest lesion upon the right side. In accordance with this indication, the laminæ of the right side were fully uncovered from the third to the sixth vertebra, and then the fourth, fifth, and sixth were removed by the rongeur, exposing the coverings of the cord. The articular process between the fifth and sixth vertebræ was also removed for the purpose of more fully exposing the canal. Then by means of bent probes the canal was carefully explored to the full extent of the region that was uncovered without detecting any bullet or any irregularity of the whole canal. There did not appear to be any destruction of the cord or of the membranes.

By means of a probe an opening in the sixth vertebra could be detected, which, however, might either have been an opening

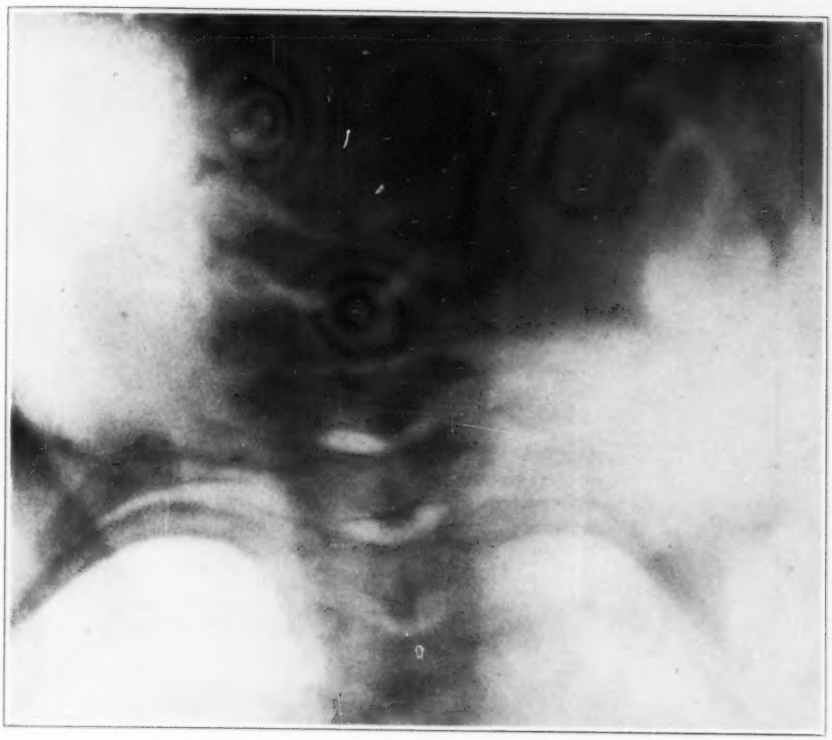

FIG. 1.—Anteroposterior view, showing bullet between fifth and sixth cervical vertebræ in midline.

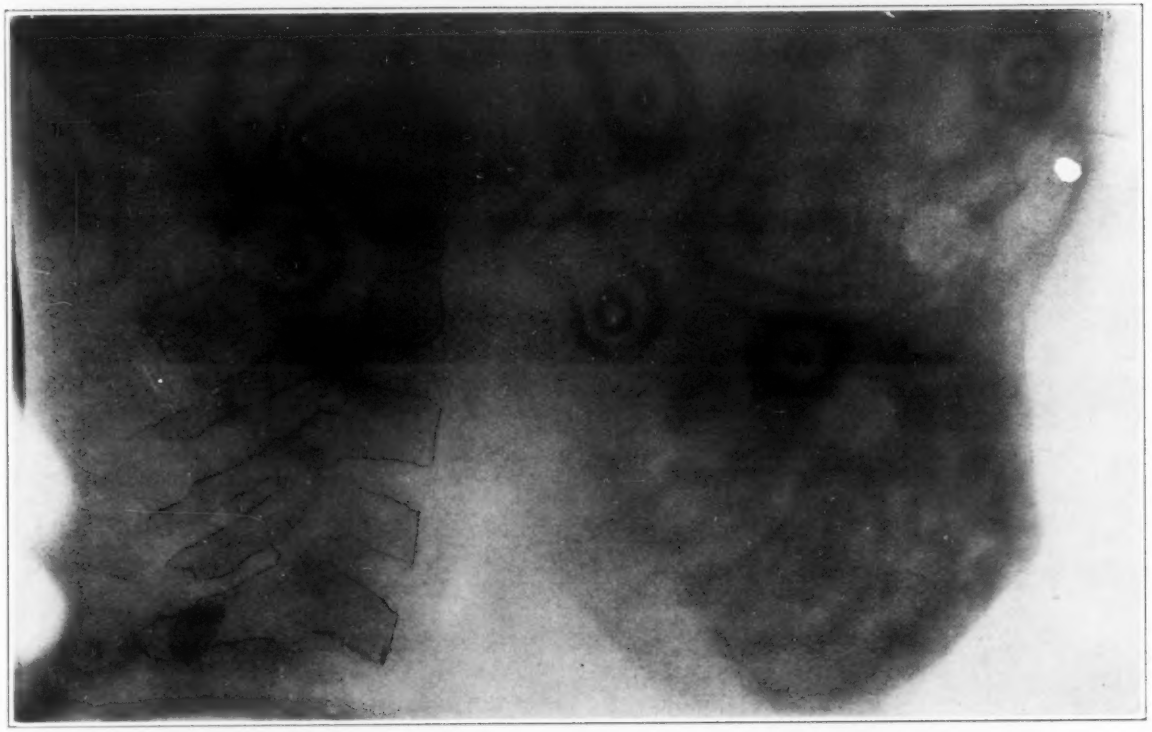

FIG. 2.—Lateral view, showing bullet embedded in the base of the spinous process of the sixth cervical vertebra.

made by the passage of the bullet, or a foramen into the body of the bone for the passage of a vein. I then opened the membranes by a longitudinal incision, and upon doing so a large amount of cerebrospinal fluid escaped; upon exposing the cord itself no lesion of the cord was demonstrable. This opening was then closed with fine silk sutures, and a light iodoform gauze tampon put down upon the opening that was left in the wall of the canal; the deep parts were brought together with buried sutures, and the greater part of the superficial wound was closed with silk-worm-gut sutures and a protective dressing applied.

The immediate effects of the operation upon the boy were quickly recovered from by him, and the second day thereafter his general condition was fully as good as it had been previous to the operation. He made a perfectly uncomplicated operative recovery, and the improvement both as regards his general morale and increasing ability to control the movements of his limbs was so marked, that at the end of two weeks from the time of laminectomy his parents took him home. During the year which followed, his ability to take care of himself greatly increased; he became able to hobble around with a peculiar spastic gait, began to take part in the sports of his fellows in the village, and upon the whole was enjoying life to the extent and degree which a boy of twelve years of age might be expected to do.

One year after the injury he was brought into the city, and a neurological examination of his condition was made by Dr. Onuf, and the result of this examination is subjoined.

At the time this examination was made finally we were able to secure a lateral view of the neck. This skiagram (Fig. 2) shows the bullet embedded in the base of the spinous process of the sixth cervical vertebra. The ball had entered just below the upper edge of the sternum, perforating the sternum, and passing backward had struck the upper edge of the seventh cervical; passing between the sixth and seventh cervical, it had passed upward and backward, and must have perforated the cord and lodged in the base of the spine of the sixth cervical vertebra behind, as would be indicated by the conditions presented in this last skiagram.

Record of examination made July 17, 1902, by Dr. Onuf.

The patient is a boy, twelve years of age; he is generally

emaciated; his head and body are habitually held bent forward, with slight lateral curvature affecting more especially lower dorsal spine. The kyphosis and scoliosis are mostly of muscular, *i.e.,* paralytic origin, which is borne out by the fact that they vary considerably in different positions and attitudes. For instance, in standing the convexity of the lateral curve is to the left and in sitting to the right.

Angles of scapulæ project when patient is standing, showing tendency to " wing" scapula. Supraspinati and infraspinati muscles are flattened at both sides, especially infraspinati. Intercostal spaces on both sides retracted, but particularly on the right side, especially from the nipple downward over fourth, fifth, and sixth intercostal spaces, which seem almost devoid of muscle; on left side the first, second, and third intercostal spaces are retracted; those below show good muscular development. In respiration there is only slight action of the intercostal muscles. Abdominal respiration also diminished. With deep respiration, compensatory action of sternocleides, trapezius and pectoralis muscles occurs. Pectoral muscles on right side markedly atrophic and flabby, those of left side also atrophic but to much less extent. Trapezius and serratus magnus show good action on both sides. Deltoids appear to act well, though right is less voluminous than left. Both arms and forearms thin. Right hand is held adducted, with fingers clinched, thumb adducted and strongly flexed; wrist semiflexed. Marked atrophy of right thenar mass; action of adductor and opponens muscles practically gone. Flexor pollicis acts fairly; interosseal spaces look puffed, but no action of interossei is apparent; hypothenar mass of right hand not much atrophied, but small finger has but little power of flexion and opposition. Grip of right hand weak, and accompanied by overextension of wrist and by supination of the hand, showing, thus, predominance of supinator over pronator action. Nevertheless, pronators not paralyzed, but acting fairly well. Extensors of right wrist act fairly well, but are decidedly weaker than normal; both flexors and extensors of wrist are weak as shown by the drop-wrist which occurs in the position of flexion or of extension according as weight of hand is acting, but the power of the extensors of wrist is better than that of the flexors; can extend fingers to a very slight degree. Abduction of right hand almost *nil,* but it is chiefly the extensor carpi ulnaris that is paralyzed,

less the flexor carpi ulnaris. Arm muscles have preserved power of action, but the latter is diminished.

Deep reflexes of upper extremities not elicitable.

Tactile sense of entire right hand somewhat dulled; of forearm and arm good. Temperature sense slightly disturbed, a little dulled in right hand.

Left upper extremity is thinner *in toto* than would be expected, although patient is in general slender and thin. No individual muscular atrophies of same. In walking, thighs are held flexed and adductors of thigh show over-action, as also the calf muscles, so that patient walks almost on the toes, the right leg showing more spasticity than left. There is marked resistance to passive abduction of thigh owing to spasm of adductor group.

Right knee-jerk strongly exaggerated, left to much less extent, but still stronger than normal.

Right foot extremely resistant to any kind of movement; after repeated manipulation typical ankle clonus.

Left foot shows also ankle clonus, but this exhausts itself more quickly than on right. Left foot also rigid to manipulation.

Feet habitually in position of varo-equinus; toes usually hyperextended, particularly in large toes; typical Babinsky sign of large toes on both sides and of all toes on left.

Temperature sense from nipple line downward impaired on both sides, most marked on the left; also impaired in upper extremities.

Pain sense preserved everywhere, tactile sense also, except in right hand as noted.

No girdle sensation and no girdle of hyperæsthesia, although patient is more sensitive to galvanic current on right upper extremity than on left.

Position sense markedly impaired in knee and ankle-joints of right side.

All movements of lower extremities are preserved, but power diminished in all of them.

Penis in condition of priapism most of time.

Left cremasteric reflex present, weak; right, absent.

Epigastric reflex present, abdominal absent.

Pupils rather wide; right slightly more so than left; palpebral fissures of equal width; no exophthalmus nor sinking in of eyeballs noticeable. Pupillary reaction to light is very prompt,

also good to accommodation. Pain reaction of pupil present on both sides.

Faradic examination of muscles of right upper extremity.

Response is absent in adductor and opponens pollicis and extensor carpi ulnaris, very weak in interossei, weak in extensor digitorum communis, fair in extensor carpi radialis, present in flexor carpi ulnaris and flexors digitorum communes; good in abductor and extensor pollicis, supinator longus and brevis and biceps, present also in other arm muscles and deltoid.

Faradic examination of muscles of left upper extremity.

Response is present everywhere, but diminished in the extensor digitorum communis and the interossei muscles.

Faradic examination of muscles of lower extremities. Shows good reaction in all muscles of extremities.

Galvanic examination of muscles of right upper extremity.

Reaction is absent in thenar muscles, weak in interossei, where An. C. C. = Ca. C. C., absent or very weak in extensor digitorum communis, extensor carpi ulnaris and biceps, absent in triceps.

Pronators and deltoid respond, as also serratus magnus and the scapular muscles.

Spinator longus and brevis and biceps show good reaction.

Galvanic examination of muscles of left upper extremity.

Response is absent in the biceps, weak in the interossei, present in the other muscles.

REMARKS BY DR. ONUF.

The neurological aspect of this case presents itself as follows:

The patient has paralytic symptoms of two kinds: Flaccid paralysis with atrophy and electrical changes in certain muscles of the upper extremities and chest, especially on the right side, and a paralysis without atrophy, affecting the muscles of the back and of the lower extremities, and being of a typically spastic nature in the latter.

The flaccid paralysis with atrophy and electrical changes denotes a lesion of the anterior horns of the spinal cord of those levels from which the nerve-fibres supplying the atrophied muscles take origin.

The paralysis without atrophy, found in the lower extremities and in the back muscles, is due to lesion of those central

motor pathways which conduct the motor impulse from the cortex of the motor region downward. These pathways in the spinal cord are situated mainly in the lateral, partly also the anterior column.

Their lesion causes a paralysis which is usually spastic, although not necessarily so; since it is now an established fact that a *total* transverse lesion above the lumbar region of the cord, even if this lumbar region itself remains entirely intact, causes a disappearance instead of the exaggeration of the knee-jerks noted in a spastic paralysis.

If the injury striking the cord affects the white and gray matter at the same time, two chief criteria are given on the motor side for recognizing the level at which the injury occurred, namely, first, the distribution and extent of the muscles exhibiting paralysis, atrophy, and the electrical changes known as reaction of degeneration. Second, the extent of the paralysis of those muscles which become only paralyzed but not atrophied, nor altered in their electrical reactions.

The first criterion, *i.e.*, the extent of the muscular atrophies and electrical changes of the same, gives a pretty exact measure of the longitudinal extent of the involvement of the anterior horn. The greater this involvement in longitudinal direction, the more muscles must become thus affected.

With the lesion in the white matter, producing the paralysis without atrophy, it is not so. A lesion severing the entire cord smoothly, I will say, at the level of the fourth cervical segment, in such manner that the wound is entirely linear and no bruises, no hemorrhage connected with it, will cause a paralysis of all the parts represented below the lesion, namely, of the upper extremities, trunk, and lower extremities. But if the said lesion, instead of destroying the white matter only at the level mentioned (fourth cervical), reached farther downward within the anterolateral column, the extent of this non-atrophic paralysis would not be any greater even if such lesions should reach five or ten or more segments downward. In other words, the paralysis without atrophy only gives us the upper level of the lesion of the anterolateral column, but not its longitudinal extent.

A further help in locating the level of a lesion are sensory disturbances, if such be present. When a complete anæsthesia is present, the upper margin of the anæsthetic area also gives

us the upper level of the lesion in the white matter of the spinal cord. Of this, some words later.

From what has been said above, it is clear that if a lesion of the spinal cord remained confined to that level at which the direct injuring force strikes the cord, the extent of the muscular atrophies ensuing would give us the most satisfactory measure of the extent and level of the lesion; but it is known that the hæmorrhages which such an injury may produce have a tendency of extending upward or downward in longitudinal columns. Thus, a hæmorrhage of the anterior horn may extend upward and downward along the latter and not spread transversely, but remain within the confines of the anterior horn. In such manner it may happen that the anterior horn is injured considerably further downward or upward than the remainder of the cord.

Nevertheless, on the whole, the extent of the lesion of the anterior horn gives a pretty fair measure of the extent and level of the lesion of the entire cord in cases of direct injury to the latter.

Returning now to our case, we find on the right side marked atrophy in the intercostal muscles down to about the sixth intercostal space.

These muscles are evidently represented in the upper dorsal segments, although we find no definite information on this point in Starr's tables.* These tables only say collectively that the second to twelfth dorsal segments supply the muscles of the back and the abdominal muscles, stating nothing at all about the intercostal muscles.

Continuing upward, we find a marked atrophy and electrical changes of certain intrinsic hand muscles (namely, interossei and certain muscles of the thenar and hypothenar), of the flexors of the wrist and the pronators, pointing to involvement of the first dorsal and eighth cervical segments.

That the seventh cervical segment, too, is affected is shown

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*M. Allen Starr: "Localization of the Functions of the Spinal Cord," *American Journal of Neurology and Psychiatry*, August and November, 1884. See also B. Sachs: "A Treatise of the Nervous Diseases of Children." New York: William Wood & Co., 1895, and Charles Dana: "Text-Book of Nervous Diseases," fifth edition: William Wood & Co., 1901. Both these books render Starr's tables with some additions and modifications gained from personal experience of these authors.

by the atrophy of the pectoralis major muscle which is represented in that segment.*

Whether the changes reach any higher in the right anterior horn, it is difficult to say. It is true that the triceps showed also marked electrical changes, but this muscle, according to Starr, is supplied by the sixth, seventh, and eighth cervical segments, and the involvement of the seventh and eighth might be sufficient to account for these changes.

The diaphragm, according to Starr, is represented in the second to fourth cervical segments, so that the fact of its involvement would make it appear as if the lesion in the anterior horn reached at least as high as the fourth cervical segment. This would also be confirmed by the presence of the atrophy of the infraspinatus and supraspinatus represented in the fourth and fifth(?) cervical segments (Starr and Sachs); but it is somewhat doubtful whether the latter atrophy is not more the expression of a general emaciation than of some spinal involvement.

However, in the first place, we do not know whether the paresis of the diaphragm is of central origin, that is, due to involvement of the anterolateral column, or whether it is a peripheral paresis, *i.e.*, due to involvement of the anterior horn.

In the second place, Kayser,† who studied the subject very carefully, places the spinal centre of the diaphragm lower down in the cord, namely, in the third to fifth or sixth cervical segment. It is also difficult to say whether the involvement of the diaphragm is due to lesion of the right or left side of the spinal cord, or both.

Nevertheless, leaving the diaphragm entirely aside, the tendency to wing scapula, indicating some involvement of the serratus magnus and the rhomboideus muscles which are represented, the former in the fifth and sixth and the latter in the fourth and fifth cervical segments (Starr and Sachs), together with the mentioned flattening of the supra- and infraspinatus, makes it probable, or at least possible, that to some extent the

* According to Starr and Sachs (loc. cit.), the pectoralis major muscle is represented in the fifth, sixth, and seventh cervical segments; therefore we may assume that the anterior horn of at least the seventh cervical segment must be involved in our case.

† Die Funktionen der Ganglienzellen des Halsmarkes." Prize essay. The Hague: Martinus Nijhoff, Publisher, 1891.

lesion reaches as high as the fifth or fourth cervical segment in the right anterior horn.

We consequently find the right anterior horn involved from the sixth (or possibly fifth or fourth) cervical segment down to the upper (possibly third or fourth) dorsal segments; with chief involvement, however, of the eighth cervical and first dorsal segments.

On the left side, beginning downward, we found an atrophy of the muscles of the first, second, and third intercostal spaces which points to involvement of the second, perhaps, also, third dorsal segment. The findings of the left upper extremity were somewhat obscured by the fact that the patient was emaciated in general and of slender build. This made it difficult to say in how much the thinness of the entire left upper extremity was due to atrophy from spinal cause, and how much to general emaciation.

However, there were decided electrical changes in the extensor digitorum communis which showed diminished faradic response, in the interossei which reacted weakly both to the faradic and galvanic currents, and in the biceps, in which the galvanic response was absent.

The said galvanic and faradic changes (leaving out the biceps, about which there may be some doubt) allow us to conclude that the anterior horn of the first dorsal and eighth cervical segments was involved to some extent. That the pectoralis major muscle, too, was attenuated would indicate involvement of at least the seventh cervical segment, since that muscle, according to Starr, is represented in the fifth, sixth, and seventh cervical segments.

How much the flattening of the supra- and infraspinatus was due to general emaciation, it is again difficult to say; but it has already been mentioned that the decided tendency to wing scapula present on both sides would point to weakness of the muscles holding the lower angle of the scapula towards the thorax, namely, chiefly the serratus magnus and rhomboideus.

The rhomboideus is represented in the fourth and fifth cervical, the serratus in the fifth and sixth cervical, and it is quite probable, therefore, that the fifth and sixth cervical segment showed some involvement not only of the right, but also the left anterior horn.

However, the most distinct and extensive changes of the

left anterior horn were evidently present in the eighth cervical to the second dorsal segment, as indicated by electrical changes in the interossei, extensor digitorum communis, and the distinct atrophy of the muscles of the first, second, and third intercostal spaces, these changes being nevertheless much less extensive than those of the right side.

Some words about the sensory disturbances that were present. There was on both sides some impairment of the temperature sense, which thermohypoæsthesia reached from below (*i.e.*, feet) up to the level of both nipples. This thermohypoæsthesia we are justified to consider as due to lesion of the white matter, probably lateral column; the central pathway for temperature sense being probably situated in the lateral parts of the lateral column.

On the other hand, the sensory disturbance in the right hand, which was of somewhat different nature, inasmuch as both the tactile and temperature sense were dulled there, makes it very probable that this hypoæsthesia of the hand was due to a local injury, namely, either of the posterior roots of the eighth cervical or first dorsal segments or of both, or of the so-called "zones radiculaires" of the posterior columns, or of the posterior horns of the same levels.

We have to add, finally, on the sensory side a decided impairment of the posture sense of the ankle- and knee-joints of the right lower extremity. As the posture sense is to a great extent dependent on muscular sensation, we shall not fail in assuming some lesion of the median * part of the right posterior column, *i.e.*, of the right column of Goll, which column, in all likelihood, conducts the muscular sense for the lower extremities. The disturbance of the muscular sense of the right lower extremity and that of the tactile and temperature sense in the right hand would find their most natural explanation by assuming one lesion, namely, an involvement of the entire right half of the posterior column at the level of the eighth cervical and first dorsal segments. At that level the fibres occupying the lateral part of the posterior column contain all the sensory root fibres from the hand, and their involvement would therefore explain pretty well the tactile

* Median. Meaning that part of the posterior column situated nearest the median plane of the spinal cord.

and thermohypoæsthesia of the right hand, while the involvement at the same level of the median part of the right posterior column, *i.e.*, of the right column of Goll, would account for the disturbance of the muscular sense of the right lower extremity.

The slight inequality of the pupils indicates some involvement of the ciliospinal centre, situated chiefly at the level of the eighth cervical and first dorsal segments. The left pupil being the smaller one, probably the left ciliospinal centre is affected, *i.e.*, partially destroyed. But in view of the absence of sinking in of the eyeball and of absence of the slight ptosis usually accompanying such an affection, the involvement of the ciliospinal centre cannot be extensive.

If we sum up all these findings, we come to the conclusion that the most extensive lesion, that is, the one comprising the largest part of the transsection of the cord, is situated at the level of the eighth cervical to about second dorsal segments, or, in other words, opposite the fifth or sixth cervical vertebra; and it is therefore fair to assume that this was the level at which the ball hit the cord. This also agrees very well with the direction of the shot canal as indicated by the point of entrance and the place where the ball became lodged. The parts affected of this level were both anterolateral columns, probably chiefly the lateral ones; furthermore, both anterior horns, particularly the right one, and probably the entire right posterior column. The nature of the lesion is somewhat difficult to judge. Probably it was partly a direct destruction by the bruising force, partly destruction by hæmorrhage, as is especially suggested for the anterior horn.

LOCAL ANÆSTHESIA.[1]

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LOCAL anæsthesia is usually accomplished by means of freezing or by the injection of cocaine or one of its analogous preparations.

Freezing may be effected by the application of ice and salt, or the ether or rhigoline spray, or, better, by spraying the parts with ethyl chloride or some of its modifications, which may be procured in suitable containers of either glass or thin metal provided with a capillary tube as an outlet.

The low boiling point of these fluids is responsible for the fact that they are always under pressure, and the simple removal of the screw-cap or the turning of a stop-cock will allow the escape of the fluid in the shape of a fine spray, which may be directed against the site of the proposed incision, and its rapid evaporation cause a freezing of the tissues.

Anæsthesia may be affected by this method in less than a minute, and may be continued for a much longer time by the continual application of the spray as the deeper structures are disclosed. But frigorific anæsthetization will be found to be most unsatisfactory. In cases where a dissection is necessary, it is very disappointing after the skin incision, owing to the changes in the tissues caused by the freezing, which make the recognition and manipulation of the structures quite difficult.

In the more simple cases, such as the opening of an abscess, the instantaneous pain caused by the incision of the unanæsthetized skin will be found to be but trifling, as compared with the pain and burning sensation caused by the freezing, and then in turn the thawing, of the tissues.

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[1] Read before the Colorado State Medical Association, October, 1903.

As a rule, it may be said that the spray of ethyl chloride will be the cause of more pain and discomfort than will a simple incision. In a large number of minor operations in which ethyl chloride was employed as the local anæsthetic by the writer, great pain was experienced both during the freezing process and afterwards; the incision, or the operation itself, caused no pain, and in practically all of the cases the incision was made and the pus evacuated, or the operation completed, before the patient was aware of the fact, but the pain afterwards, during the thawing, was many times very severe.

The more common and satisfactory manner of producing local anæsthesia or analgesia is by the subcutaneous injection of a solution of cocaine or some of its succedanea.

Cocaine, as an anæsthetic, was first employed almost exclusively in ophthalmology, and was first presented to the profession by Koller, of Vienna, at the Ophthalmic Congress of 1884, at Heidelberg. The anæsthetizing action of the drug is supposed to act in part by the anæmia produced by the stimulation of the vasomotor constrictors, and in part by a paralysis of the end organs of the sensory nerves. Cocaine is by no means the only substance used for the production of local anæsthesia by injection; in fact, there are many, such as Eucaine A, Eucaine B, Tropocaine, Nirvanin, Orthoform, Anæsthesia, Holocain, etc.

The chief reason for such a large number of substitutes is the danger of systemic poisoning from the absorption of cocaine. The toxic effect of cocaine varies considerably, but the usual and chief symptoms are such as, loss of speech, blindness, nausea, vomiting, and syncope. Vertigo is often the first symptom, and may sometimes be followed by convulsions. The pulse and respiration often become very irregular and rapid.

Out of 250 reported cases of accidental poisoning with cocaine, thirteen terminated fatally.

The treatment consists of ammonia, coffee, strychnine, ether, alcohol, morphine, and dorsal decubitus, if collapse threatens, while, if of the convulsive type, amyl nitrite, bromide, chloral, etc., are indicated.

In order to prevent such untoward effects, and at the same time to prevent the action of the drug injected from being too evanescent, it is advisable to constrict the limb or the part of the body into which the injection is to be made.

The addition of adrenalin chloride to the anæsthetic solution is recommended as a precaution against the occurrence of such symptoms. But such accidents should not occur, at the present writing, after the efficiency of the weaker solutions has been demonstrated, and the use of practically non-toxic surrogates of cocaine has succeeded that of cocaine itself.

The most rational treatment consists of prophylaxis, *i.e.*, the employment of non-toxic substitutes for cocaine, or if cocaine proper is preferred, it should be used in very dilute solutions.

Or if, for any reason, the older and stronger solutions are employed, it should be an arbitrary rule never to inject more than one-quarter grain of cocaine at one sitting, although some authorities give one grain as the maximum dose.

In a recent series of fifty cocaine injections for analgesia in various pathological conditions, evil effects were noted in three instances.

1. Epithelioma removed from the hand of a woman sixty-six years of age. She became delirious and talked incoherently, pulse and respiration became rapid. After the wound was closed she was put to bed and given strychnine hypodermically; in about half an hour she became perfectly rational, but could remember nothing that occurred at the time of the operation.

2. Ganglion removed from the hand of a young woman nineteen years of age. Without any premonitory symptoms, she suddenly complained of dizziness, and almost immediately became unconscious; her pulse and respiration remained normal; the operation was completed, and a few minutes after she suddenly revived and felt perfectly well.

In each of the above cases the strength of the solution employed was 1 to 10 of 1 per cent., and not over sixty minims were used in either instance.

3. Sequestrotomy of tibia; man thirty-four years of age.

During the course of the operation pulse and respiration increased; the patient became excited and talked at random, but complained of no pain. After being placed in bed and the administration of strychnine he became rational, but could remember nothing of the operative procedure.

In this case, analgesia was accomplished by the regional method, Schleich solution No. 2, by infiltration; about two drachms were used in exposing the sciatic and the anterior crural nerves, then about ten minims of cocaine, 1 per cent., into the nerves.

In a series of over eighty cases, in which Eucaine B was employed as the local anæsthetic, no such symptoms made themselves manifest.

But it must be remembered that such symptoms as those presented in the above cases are not necessarily due to the toxic action of the cocaine, for, instead, they may be due entirely to nervous or psychic phenomena. And even deaths which have been accredited to general or local anæsthesia might be accounted for in the same manner.

Death from fright is neither an unknown nor an impossible circumstance, as such cases are on record, and had these accidents been preceded or accompanied by an anæsthetic, the death would have been held against the particular agent employed.

Reclus has done 7000 operations under local cocaine anæsthesia, and in all these has never met with a death that could be in any way attributed to it.

He places great importance upon the following rules.

1. Never use a stronger solution than 5 per cent. or 1 per cent.

2. Always have the patient recline during the administration of the anæsthetic, and not get up for half an hour after the operation is completed.

3. Always have the patient eat or drink something before arising.

Reclus has carefully searched the literature, and has been unable to find a single published case of mishap in which these rules had been followed or even approximated.

Another objection to the use of cocaine is the claim that it cannot be rendered sterile, as heat will cause it to become decomposed.

But Cushing, in speaking of the Schleich solution, says, "Contrary to the experience of many, we have found that one or two sterilizations fail to diminish its efficiency."

Riley has emphasized the necessity of a proper selection of the cocaine crystals, and then, regarding the sterilization of it, says, "One hour's heating of the dried cocaine at this temperature, 302° to 320° F., does not impair its efficiency, notwithstanding many statements in the books to the contrary."

And Matas says, "Repeated experience has taught me that cocaine solutions can be heated up to the boiling point for a number of times without losing their efficiency."

These disadvantages, toxicity and the inability to sterilize, have been the chief reasons why cocaine has been superseded by the use of other preparations in local analgesia. Though Cushing and others find in eucaine an agent less satisfactory than cocaine.

Eucaine A, the first product to bear the name, was of but little or no improvement over cocaine; but Eucaine B, or the improved preparation, has for its most characteristic and advantageous features the following: (*a*) Non-toxicity, the fatal dose being so large, between .4 to .5 gramme (6 to 7.5 grains) per kilogram (2.5 pounds) of body weight, that there is practically no liability of such a lethal dose being injected in the course of an ordinary local anæsthesia. (*b*) It may be sterilized by heat without the loss of any of its anæsthetizing properties. (*c*) It will not deteriorate or decompose with keeping, (*d*) and, it is claimed, will not increase the tendency to hæmorrhage to any marked degree; that vasomotor paralysis and secondary hæmorrhage will occur less frequently than after the use of cocaine. These points have been the most influential in placing Eucaine B as the local anæsthetic of choice, and its use is being rapidly increased.

Local anæsthesia has made most wonderful and marvellous strides in development and expansion since its introduction.

At first cocaine was employed in high percentages and alone, for the more comparatively insignificant minor operations of surgery. Since then its use has been extended into all the branches of general surgery and the specialties, but few of the major as well as the minor operations have not at some time been performed under local anæsthesia.

In 1885 its use was practically confined to ophthalmology, and in surgery to the anæsthetization of the skin, previous to the lancing of a boil.

In 1902 we read of a case of "Cæsarean Section under Local Anæsthesia."

The interval in time being filled by its gradual adoption, dependent upon improvements that were being constantly made, and its being utilized in almost all of the possible intervening operations.

Local anæsthesia, or analgesia, may be divided into three subdivisions:

1. Direct anæsthesia.
2. Infiltration anæsthesia.
3. Regional anæsthesia.

1. By direct anæsthesia is understood the injection of the anæsthetic substance directly into the tissues, subcutaneously, at the site of the proposed incision, where it acts directly, chemically, upon the nerve endings of the region. Also in the application of the anæsthetic substance to the mucous membrane that is to be interfered with surgically, as in the eye, nose, pharynx, urethra, or rectum.

The strength of the solution to be applied to the mucous membrane will vary from 2 per cent. to 10 per cent., and for the injection under the skin, 5 per cent. or 1 per cent. are as strong as are usually employed, but in the early days of its use 10 per cent. and even 20 per cent. solutions were employed. But the evils associated with these strong solutions soon lead to the adoption of the smaller percentages, and these in turn have been superseded, to a very large extent, by the so-called "Infiltration Anæsthesia."

2. Infiltration anæsthesia constitutes a marked improve-

ment in local analgesia, and was presented by Schleich in 1899, in his "Schmertzlose Operation." Although Halsted, in this country, and others on the continent had independently noted the physical phenomena which serves as a basis of this particular form of anæsthesia, *i.e.*, the intradermal instead of the hypodermal injection of the solution, and the utilization of very dilute solutions of cocaine or its substitutes, or even plain water, depending for the analgesic effect, to a large extent, upon the physical conditions, such as the œdema, stasis or ischæmia in the blood-vessels, pressure upon the terminal nerve filaments, and a low temperature, rather than to the direct chemical action of the analgesic drug or drugs.

The different Schleich solutions are composed as follows:

	No. 1.	No. 2.	No. 3.
Cocaine muriatis	gr. iv. (0.2)	gr. ii. (0.1)	gr. $\frac{1}{5}$ (0.01)
Morphine muriatis	gr. ½ (0.025)	gr. ½ (0.025)	gr. $\frac{1}{10}$ (0.005)
Sodii chloridi	gr. iv. (0.2)	gr. iv. (0.2)	gr. iv. (0.2)
Aquæ destillatæ	dr. iv. (120.0)	dr. iv. (120.0)	dr. iv. (120.0)

From the above formulæ there are many variations and modifications, but they are the foundation or the basis for the others. The second solution is the one ordinarily employed; the first is reserved for those cases in which there is an acute inflammation and hypersensitiveness; the third is recommended where a large amount of the solution will be required.

Constriction of the part, if possible, or the chilling by the low temperature of the injected fluid, or the external application of cold is recommended, because a retardation of the circulation in the infiltrated area will augment the action of the injected drugs, and while prolonging the anæsthesia will at the same time diminish the dangers of over-absorption and the occurrence of intoxication; likewise allowing of the administration of a much smaller dose than would be necessary if these precautions were not followed out.

With the same results in mind, Braun, of Leipsic, earnestly advocates that adrenalin chloride be exhibited before or with the infiltration solution. And in a recent communication

emanating from the clinic of Bier, the administration of adrenalin, previous to the spinal anæsthesia, is recommended.

As a cardiac stimulant, adrenalin will also be indicated in overcoming the depressing action of cocaine or eucaine.

Another reason for incorporating adrenalin chloride in the infiltration solution will be because of its hæmostatic action. In the proportion of from 1 to 5000 to 1 to 20,000, it will be found to decrease the capillary hæmorrhage to practically nothing.

The tissues for about two inches surrounding the injected area become blanched. The vessels remain contracted for a couple of hours, and so prevent postoperative congestion and pain. From a very large experience, it has been found in no way to favor the occurrence of secondary hæmorrhage.

With the above solutions and their modifications the skin can be most readily and satisfactorily rendered non-sensitive, the panniculus cannot be œdematized, and, therefore, according to Schleich, it cannot be anæsthetized by infiltration. But, as a rule, it will never be found necessary to attempt to anæsthetize the panniculus after the skin has been rendered analgesic. The deeper underlying structures can be infiltrated similarly to the skin, and with the same solution.

The muscle, fascia, aponeurosis, and even the periosteum, may all in turn be rendered completely non-sensitive by this method, and, owing to the weakness of the solution, the small percentage of cocaine, the danger of symptoms arising from the over-absorption of the drug is very slight.

The temperament of the patient, especially the psychic element, the manner of introducing the solution, the personal equation of the operator, and, above all, an accurate knowledge of the minute nervous anatomy of the region, are of great importance in determining the success or failure of the method.

In order to render the first prick of the syringe needle unnoticeable, ethyl chloride has been recommended, but a drop of pure carbolic acid from the end of a probe will at the same time sterilize and anæsthetize the point.

For large or massive infiltrations, Matas has devised a

special apparatus with the object of dispensing with the troublesome and time-consuming filling and refilling of the ordinary syringe.

Similar automatic syringes have been devised in Germany.

The administration of morphine sulphate, one-quarter of a grain, hypodermically, fifteen or thirty minutes before the injection of the anæsthetic, has become almost a routine measure; it is indicated in all major or long cases, and especially in nervous or timid patients it will be found to act as a most satisfactory soothing and quieting adjuvant to the local anæsthesia. The morphine is also of value in this manner, as it is a true antidote to cocaine.

The chief contraindication, outside of idiosyncrasy, will be found in its constipating action upon the bowel.

In some instances, because of the moral effect upon the patient, or because of a desire to use the smallest possible amount of general anæsthetic, on account of various conditions, the use of morphine and then cocaine may in turn be followed by the inhalation of chloroform. This morphine-cocaine-chloroform anæsthesia will be found to be very advantageous in reducing the amount of general anæsthesia necessary in a given case; and, again, it may be deemed advisable to administer a small amount of inhalatory anæsthetic, even though the field of operation may be proven analgesic, for its moral or quieting effect upon an extremely nervous individual.

It has been generally acccepted that the analgesic action of this infiltration was due, not so much to the direct chemical action of the anæsthetic agents employed as to the physical action of the solution itself.

As a matter of fact, Schleich claims that thorough œdematization of the skin with a 2 per cent. salt solution, which is of a lower temperature than the body, is all that is essential in infiltration anæsthesia.

The analgesic drugs that are added in very small percentage are merely for the purpose of overcoming a hypersensitiveness of pathological tissue.

Simple œdema, caused by plain or sterile water, will cause

an anæsthesia, but a very short and painful one, and is known as the "Anæsthesia Dolorosa," of Liebreich.

An œdema caused by the injection of .2 per cent. salt solution is practically painless; a solution, in order to cause little or no pain, must be isotonic, *i.e.*, having the same specific gravity, and the same freezing point as that of the normal tissues into which it is injected. More concentrated solutions will absorb water from the cells, and so give rise to pain. Less concentrated solutions cause the cells to swell, and in this way cause pain.

But this theory as to the exclusively physical action of the infiltration anæsthetic will be found to be severely attacked by Marchinowski, who claims, after experimentation and clinical observation, that the local anæsthesia by infiltration or simple injection is always and only due to the poisonous action of the drugs upon the terminal nerve filaments.

He further claims that swelling, pressure, irritation, and differences of osmotic pressure and of temperature disturb and interfere with the anæsthetic, and in no way aid in the production of anæsthesia, nor in its maintenance when once established.

The fact that anæsthesia can be produced by the pure and simple œdema caused by the injection of an isotonic solution has been demonstrated, but it is an anæsthesia impracticable in surgery, or, as Matas says, "My personal experience has convinced me that if the cocaine were excluded from them (Schleich's solution), they would cease to be of value as practical surgical anæsthetics."

The infiltration method, while eminently satisfactory in many cases, in others it is not sufficient; especially is this true in those cases involving an extensive dissection, or in which large nerve-trunks are to be severed. In these major operations, a more satisfactory anæsthesia is accomplished by means of what has been termed regional or regionary anæsthesia.

3. Regional anæsthesia consists of the injection of a comparatively strong, 1 per cent. to 3 per cent., solution of the anæsthetic agent into the sensory nerve that supplies the field

of operation, usually at a convenient point between the central nervous system and the site of operative interference, although in some cases the nerve or nerves may be injected when they are exposed in the operative wound.

A combination of the infiltration and the regional methods is usually employed, the former for the skin and the superficial parts, during the dissection and isolation of the nerves; and then the latter, by the direct injection into the nerve.

At times it may be inconvenient to expose the nerve by dissection, and then an injection into the perineural tissues will, as a rule, be found ample and sufficient. The injection should be made into the region of the nerve that is to be interfered with, and the nerve surrounded by what Matas terms an "Anæsthetic Atmosphere."

This acts in the same manner as an intraneural injection, prevents the passage of impulses, and results the same as if the nerve was divided at this point, the so-called "Blocking," which allows of the carrying out of operative procedures distal to the injection without the occurrence of pain.

Another point regarding this "Blocking," as shown in the splendid works of Crile and of Cushing on the subject of shock, is that by so blocking the nerve, centripetal impulses are prevented from reaching the centre, and in this way remove one of the most important, if not the chief, causes of shock.

Under general anæsthesia, the afferent impulse of pain is not received, or at least not recognized, by the centre; but other afferent impulses caused by various factors, such as mechanical, thermal, electrical, or other stimuli, which act deleteriously upon the circulatory, respiratory, vasomotor, and sympathetic systems, are not interfered with, and these, on reaching the centre, give rise to the symptom complex known as "shock."

In local regional anæsthesia there exists what Crile has termed a "Physiological Amputation," and such impulses are absolutely blocked, and, in consequence, shock diminished or prevented. This procedure, the blocking of large nerves, should be carried out in amputations, even though a general anæsthetic is administered.

The application of infiltration and regional anæsthesia has been enlarged very rapidly during the last few years, and is assuming a position of importance in the subjects of anæsthesia and of surgery.

The experience upon which this article is based includes over 100 operations for various pathological conditions, in which local anæsthesia, as above considered, was administered.

The operations were such as:

The incision and drainage of abscesses in different parts of the body, including ischiorectal, peri-urethral, and appendiceal.

The removal of ganglion, epitheliomata, lipomata, bullets, and other foreign bodies, to enable the proper cleansing of crushed fingers and toes.

Amputation of fingers and toes and tenorrhaphy.

Sequestrotomy of tibia.

Freshening the edges of fractured tibia, for non-union.

Removal of internal saphenous vein, for varicose ulcer.

Plastic operations on nose and face.

Removal of tubercular glands of the neck and goitre.

Resection of rib for empyema.

Radical cure of inguinal and ventral hernia.

Radical cure of hydrocele, varicocele, and phimosis.

Appendicectomy, Talma operation, suprapubic cystotomy, exploratory laparotomy.

Internal urethrotomy, removal of hæmorrhoids, and urethral caruncle.

In all of these various operations, in only one instance was there anything like an unsatisfactory result, the others being most satisfactory in their final outcome.

In one of the eight inguinal hernias operated upon by the aid of local anæsthesia, there occurred a sloughing of the skin of the margin of the wound.

A brief history of the case is as follows:

Mr. S., American, miner, seventy-eight years of age. Came to St. Vincent's Hospital for treatment of a varicose ulcer of the

right leg. He has not been in good health for a number of years; was injured in a mine, and had his foot severely crushed, since then he has been very "nervous."

In the course of the examination, his nervousness was found to be a paralysis agitans; his arteries were markedly sclerotic, with an enlarged liver and a chronic bronchitis.

Besides the varicose ulcer, there was discovered a large oblique inguinal hernia on the left side, and on the right side a direct inguinal hernia.

The left side, he informed us, came down suddenly while lifting a trunk about two years previous; about six months afterwards he noticed a swelling in the inguinal region of the right side. He had been wearing an improperly fitting truss for about a year, but the swelling was gradually becoming larger.

As it would be necessary to confine him to bed in the treatment of the ulcer, it was suggested that he have the hernias operated upon at the same time; but he expressed himself as being afraid that he was too old to stand the chloroform.

When it was explained that it would not be necessary for him to go under the influence of either chloroform or ether, he was very anxious that the operations should be performed.

The operations were usual in every particular, and the technique of the anæsthesia the same as in the other cases. Schleich solution No. 2 was employed.

Ferguson operation on the left side, and on the right side a plastic procedure, as the conditions warranted.

The deeper sutures were of formaldehyde gut, and, instead of inserting skin sutures, on account of the very poor condition of the blood-vessels, the skin wound was united by means of strips of adhesive plaster. The patient complained of no pain whatever during or after the operation, and the blood-pressure during the operation did not vary over five millimetres, according to the Riva-Rocci sphygmanometer.

On the third day he complained of slight pain on the left side; there was no temperature, but the dressings were changed, and the following conditions disclosed.

The wound of the right side normal. The wound of the left side had made no effort at repair; the deeper structures seemed to be united perfectly, but the skin was separated by a gap at the incision. The external margin of the wound was thickened,

dark, and gangrenous in appearance for a distance of from a quarter to half an inch from the cut edge.

The internal margin of the wound was similar in appearance, but the swelling did not extend over a quarter of an inch from the incision. Wet dressings were applied, and the next day these necrotic portions were removed with scissors, and the wound packed with gauze.

At no time were the sutures of the external oblique muscle visible.

At no time was there any interruption in the primary union of the wound on the right side.

It would seem, *a priori*, that this sloughing was caused by the infiltration, in that the temporary ischæmia had remained as a permanent one. But, on the other hand, it is difficult to explain in what manner, or as a result of what, this unusual termination occurred. Had superficial stitches been employed, the explanation would have been very naturally that they had been tied too tightly.

The same solution, in about the same amounts, was used on both sides; the two operations were of practically the same duration and severity; and, while the resistance of the patient was considerably below par, there is no convincing reason for the belief that there was less resistance on one side than on the other. The presence of infective matter in the solution will, of course, be considered as a possible cause, but the isolation of the trouble to one side will make such an explanation doubtful.

This accident the writer wishes to be placed on record as an accompaniment of local anæsthesia, in this particular instance; as to whether it should be correctly classed as a result or not, will be shown by further experience and wider observation.

Bad as this circumstance was, still, it is to the credit of local anæsthesia that this individual could be operated upon and relieved from the danger and the trouble of his hernias.

For a general anæsthetic was most certainly contraindicated in such a case as this, especially so for the undertaking

of an operation which would not be directly a life and death measure.*

The above list of operations which have been included in the writer's experience, by no means constitute a catalogue of the conditions in which this mode of anæsthesia has been successfully utilized.

As stated above, it has been employed, with more or less success, in almost every operation in the list of surgical possibilities.

As showing the important position that local anæsthesia has assumed, attention may be called to the fact that Mikulicz has classified operations into

1. Operations in which a local anæsthetic is positively indicated.

2. Operations in which a general anæsthetic is positively indicated.

3. Borderline operations.

Under 1 are placed extirpation of small non-malignant tumors, tracheotomy, gastrostomy, strangulated hernia, etc.

Under 2, extensive operations on the head, majority of laparotomies, removal of large malignant growths, such as carcinoma of the breast.

Under 3, gastro-intestinal operations, goitre resections, herniotomies.

Various objections have been raised against the use of local anæsthesia; but it would seem, after a comparative study of the two methods, that the chief objections are to be found on the side of general anæsthesia in those cases allowing of local anæsthesia.

The danger of sepsis has been considered serious by some, but with a careful and ordinary aseptic and antiseptic technique it has been practically eliminated.

The occurrence of shock and nervous prostration has been

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* Three months after operation, Mr. S. presented himself for examination, and at that time no evidence of recurrence was apparent.

The patient states that on the tenth day after his discharge from the hospital, he rode on horseback from Aspen to Leadville, fifty-four miles.

considered as one of the terminations to be expected after the performance of an extensive operation under such an anæsthesia.

Deaver has said, "Local anæsthesia, as used by Kocher, in goitre operations cannot become popular in this country, where people are more susceptible to shock . . .; the fright of so severe an operation as thyroidectomy would result in greater shock."

On the other hand, Huntington, in speaking of Basedow's disease, says, "The facility and thoroughness with which local anæsthesia can be accomplished is almost universally recognized. . . . Cocaine, or one of its analogous compounds, has supplanted chloroform and ether, and their great value is manifest in this over all other applications of these drugs."

He also advocates the cocainization of the nerve-trunks that supply the region of the gland, and reports cases in which the cervical (superficial) was blocked, as is done, for example, in hernia operations.

This is a most important innovation, because the nerves in and about the glottis are capable of exerting inhibitory influences upon the cardiac and respiratory centres. Manipulation or other stimuli may excite this inhibitory function, but it would seem that by this blocking such evil effects may be prevented. By the introduction of a minimal amount of the solution, the entire operative area may be rendered analgesic, and at the same time shock may be prevented.

Curtis says, "I have employed local cocaine anæsthesia in thyroidectomies for ordinary goitre with excellent results, but hitherto have hesitated to use it in operating upon patients with exophthalmic goitre, because I feared the effect upon the heart. But hereafter I shall make a trial of it in these cases too."

Witherspoon, in speaking of the same condition, says, "A general anæsthetic is dangerous, and those who operate under general anæsthesia are going to obtain poor results."

These quotations, in a way, show the status of opinion regarding local anæsthesia in simple and even exophthalmic

goitre; similar expressions of opinion could be quoted in connection with most of the other operations in which this method of producing anæsthesia has been employed.

The fear of the patient that he is going to be hurt has been presented as an objection. This fear may be present at the beginning of the operation, but it is soon dispelled if the anæsthesia is carried out properly, and replaced by a commensurate sense of relief in the discovery that he is not being hurt.

The occurrence of actual sickening pain when the viscera are being handled is a serious drawback to the method in laparotomies where visceral adhesions are to be separated.

The visceral peritoneum, under normal circumstances, is non-sensitive when compared with the parietal; but in making traction upon the mesentery, or attachments of other intra-abdominal organs, a dull dragging ache will make itself manifest that will, in many cases, demand a general anæsthetic.

In one laparotomy, in the writer's experience, local anæsthesia did very well until an attempt was made to break down some of the adhesions in the pelvis. This could not be done without a general anæsthetic; but as it was a so-called morphine-eucaine-chloroform anæsthesia, the amount of the latter was very small as to what it would have been without either of the other agents. The presence of intra-abdominal adhesions that demand separation is in itself a contraindication to the farther use of local anæsthesia.

The advantages to be derived from the employment of local anæsthesia are many, the first and foremost being:

1. Removal of the danger of death on the table. Others which may be mentioned are:

2. Avoidance of the after effects of general anæsthesia on the heart, liver, kidney, and lung; but postoperative pneumonia seems to occur about as frequently after one anæsthesia as the other.

3. No period of postoperative nausea, vomiting, or unconsciousness.

4. No danger of patient being drowned in fæcal vomitus.

5. Patient, being conscious, is able to assist the operator in various ways.

6. Reducing by one the number of assistants; although it will be found to be convenient to have an assistant at the head of the patient to encourage and reassure him, and to be ready to administer a whiff or two of chloroform, if necessary.

Da Costa has said, "Valuable as the method is, it should be used as an adjuvant to, rather than a supplanter of, general anæsthesia."

This statement we would attempt to enlarge upon by remodelling, as follows: Valuable as the method is, it should be used as an adjuvant to, when not possible as a supplanter of, general anæsthesia.

That there are many cases in which local anæsthesia is markedly contraindicated, there is no rational doubt. And, on the other hand, that general anæsthesia is many times employed unnecessarily is a fact.

We do not urge the promiscuous use of local anæsthesia, but we do urge an appreciation of the fact that local anæsthesia is safe and practicable, and better than general anæsthesia in many cases where the latter is commonly employed. And in attempting to impress this fact, we can do no better than to quote from Von Mikulicz, who has said,—

"The question of to-day is *not* which is the safer anæsthetic, chloroform or ether, but in what cases can local anæsthesia be substituted for anæsthesia by inhalation."

AN EXPERIMENTAL RESEARCH INTO THE TEMPERATURE RELATIONSHIP EXISTING IN SHOCK.[1]

BY GUY C. KINNAMAN, M.D.,

OF CHICAGO.

INTRODUCTION.

FREQUENTLY, while assisting my father, Dr. R. C. Kinnaman, in his surgical practice, and especially that in connection with railroad injuries, I have had occasion to notice the fact that, when the injured person was allowed, either from negligence or non-discovery, to lie upon the ground for any length of time, shock in every instance was much more severe than if the patient were immediately put upon a board or cot and well covered with blankets. This seemed to indicate strongly that the increased loss of body heat incident to the contact of the body with the ground must be an important factor in the resulting increased degree of shock. And, reasoning from this assumption, it appears logical that, in any degree of shock, the rôle of the temperature fall is worthy of a much more prominent part than the very minor one now given it.

With the purpose in view of establishing to a certain degree at least the temperature relationship existing in shock, a number of experiments have been made upon dogs. Believing that a short review of the experimental work, clinical experience, and ideas of the various men upon the subject of shock will not be out of place in this connection, it has been added.

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[1] A Thesis awarded the Fellowship in Surgery at Rush Medical College, in affiliation with the University of Chicago.

NOTE.—I desire to take this opportunity of thanking Dr. S. A. Matthews and Dr. R. A. Smith for their valuable assistance in the experimental part of the work. I am also indebted to Professor Lyon for the use of the Physiological Laboratory of the University of Chicago, where these experiments were conducted.

Experimental work and clinical experience are worthy of the most attention, for they give a working basis.

METHOD OF PROCEDURE AND APPARATUS.

Dogs, taken as furnished by the laboratory assistant, were used as subjects. In every case ether was used as the anæsthetic, and was administered by a cone over the dog's nose and mouth. Although it would have been easier to have given it through a tracheal cannula, it was thought better not to submit the dog to avoidable manipulation and injury in the cervical region, and thus simplify the experiment and rule out any effect the procedure might have upon the result. The blood-pressure was taken from the right carotid. After cutting through skin, the carotid was reached by blunt dissection, thus avoiding hæmorrhage. The vagus was very carefully separated from its sheath connection with the carotid so as not to injure or stretch it. The cannula in the carotid was then connected with an ordinary mercurial manometer. Time was marked by means of a long, heavy pendulum, which in its swing back and forth was so arranged as to make and break once a second an electrical current furnished by cells in series. A current thus interrupted was then connected up to a transmitter attached to a kymograph. This transmitter, by means of a rather long arm to which the writing-pen was attached, by the movement of this arm up and down every second thus recorded the time in seconds. For recording respirations, a very elastic band, one inch wide, was used, encircling the lower part of the chest. A small leather pocket was sewed to the under side of the band. Into this pocket an elastic rubber bulb was placed, thus being between band and chest. The bulb was connected by means of rubber tubing to a tambour attached to kymograph. Tambour was of the ordinary variety. To the rubber dam forming the upper surface of the tambour a small steel lever was attached by means of a small, light plate, which in turn was glued to the rubber dam. At the end of lever the writing-pen was attached. At every respiration the air in bulb would be compressed; compression would be transmitted to

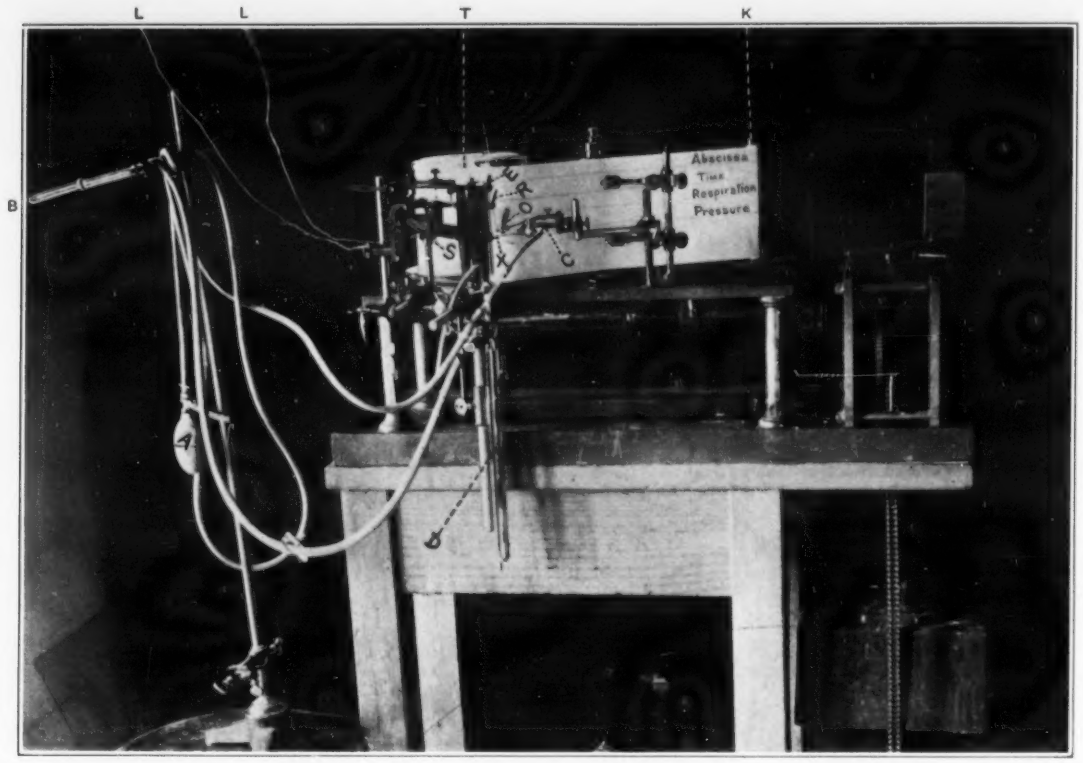


FIG. 1.—Kymograph and attachments.

tambour along the rubber tube, and the rubber dam forming the upper surface of tambour would be stretched upward; lever would move upward, and thus the pen at its free end would record the strokes. The up stroke represents inspiration, the down stroke expiration. The records were taken upon a continuous roll kymograph. Ordinary white roll paper, cut in the proper size, was used. Records were made upon it by pens made of small glass tubing drawn at one end to a capillary tube. Into each pen a bristle free from fat was inserted, causing the ink to feed and act as a pen point.

DESCRIPTION OF KYMOGRAPH AND ATTACHMENTS FROM PHOTOGRAPH (FIG. 1).

A. Respiratory bulb.

B. Glass tube, which is connected with cannula in carotid by means of rubber tube. This glass tube is continuous with rubber tubing connection with manometer at M.

C. Respiratory tambour, with which A is continuous by means of rubber tubing.

D. Mercurial manometer.

E. Pen marking abscissa line and also acting as signal.

R. Pen recording time.

O. Pen recording respiration upon lever from C.

X. Pen of manometer recording blood-pressure.

S. Time transmitter.

L.L. The electrical connection between transmitter and pendulum and cells.

T. Large roll of paper.

K. Revolving pin which slowly winds the paper from T upon itself.

By using this kymograph continuous tracings were made from the beginning of the experiment to the end. Thus at any time during the progress of the experiment the blood-pressure and respiration can be observed. The temperature was taken per rectum. A very sensitive Centigrade thermometer, graduated in tenths of a degree, was used.

Shock was produced by two methods: (1) Simple exposure of intestines to the air; (2) Exposure plus vigorous manipulation. In exposing the intestines, an excision varying from two and one-half to three inches in length was made in the linea alba, the exposure being practically bloodless. Peritoneal incision was much smaller. The intestines were then drawn out and spread upon the abdomen. In this manner the descending and sigmoid flexures of colon and the rectum were not exposed to the air; therefore the temperature taken in the rectum was a reliable index of the body temperature. In the Series B and C, where the dog was placed in a warm bath, a child's bath-tub was used, and this was filled with enough normal salt solution to cover the dog's body and exposed intestines. The head was held suspended above the liquid by means of a strap under the neck. In taking the rectal temperature while in the bath, the posterior half of the body was lifted free from the bath and held there for a minute before inserting thermometer and taking the reading, thus eliminating the direct effect of the bath upon the tissues.

The original observations and the continuous tracings of each experiment are carefully filed, and any statement made can be verified from them. At the risk of being verbose, everything which was observed in the experiments that might have a bearing upon the condition of shock has been recorded in the protocols. Sections of the tracings have been appended in order to help demonstrate the various changes occurring during the progress of the several experiments.

BIBLIOGRAPHY.

In 1795, James Latta[1] gave the name of "shock" to that peculiar state of the body functions following upon a severe injury. Before that time the recognition of the condition was not clear, and the names applied to it were unmeaning. Then, although the condition was known, it received practically no attention until the latter half of the last century, when it was again brought into prominence. From that time down to the present there has been a gradually increasing interest shown

in the consideration of shock from its clinical stand-point and to a much less degree, experimentally. A number of theories have been advanced in regard to its cause,—some without any tangible foundation, some from consideration of the clinical aspect, and some, by far the smaller third, from animal experimentation. The theory advanced by Brown-Séquard is that the symptoms of shock are caused by anæmia of the cerebral centres due to a more or less persistent contraction of the capillaries through the vasomotor centre. Jordan [2] describes it as a peculiar condition of the animal organism characterized by an arrest of all functions brought about by a severe influence upon the central organs or a considerable portion of peripheral distribution of the nervous system. Fisher [3] ascribes it to a weakened condition of the heart caused by reflex vasomotor paralysis. Goltz,[4] by tapping on frog's abdomen, caused the heart to stop in diastole. He thought the result due to general vascular paralysis. Likewise Drs. Mitchell, Moorehouse, and Keen [5] held a theory of reflex vasomotor paralysis.

Mansell Moullin [6] takes a broader view, and says that shock is an example of reflex paralysis in the strictest sense of the term; a reflex inhibition, probably in a majority of the cases general, affecting all the functions of the nervous system, and not limited to the heart and vessels only. Savory [7] says, "Death from shock is the result of a sudden and violent impression on some portion of the nervous system acting at once through a nerve centre upon the heart and destroying its action." In support of his idea, he says that if an animal be killed by sudden destruction of cord and brain, and chest opened in from one to two minutes, the heart is found motionless or slightly flickering and distended with blood. But such an experiment is more like annihilation than what we understand by shock. This may be considered all that has been advanced in support of the cardiac-paralysis theory. Roger [8] states that in shock, "Reflexly there are produced inhibitory acts, the principal of which is the arrest of the exchanges between blood and tissues," and as a result the venous blood becomes red, the respirations slow, and temperature diminishes one to two or

more degrees. He used guinea-pigs as subjects. But this same theory was presented several years previously by McGuire [9] who designated it as "Systemic Asphyxia." Estes [10] defines shock as an acute cerebral anæmia. Boise [11] explains the symptoms of shock as being due to hyperirritation of the entire sympathetic system, with resulting stimulation of vasomotors, contraction of arterioles, and spasmodic heart action. He says therapeutic measures meet his theory, for they are sedative to sympathetic system and relaxants to arterioles. But the therapeutic treatment is not a grand success by any means, and gives but a very uncertain foundation for a theory. Ziegler [12] says that shock is chiefly characterized by weakened energy of heart's action, by an irregular breathing, which leads to a decrease in the interchange of gases in the tissues, and by a lowering of the temperature. Arnold [13] states that "The phenomena of shock are due primarily to a morbid impression upon that portion of the nervous system which presides over nutrition and from a partial arrest of the latter." He means trophic disturbance. Seabrook,[14] from a series of experiments upon frogs and rabbits, draws the conclusions: (1) That the vessels (arteries and veins) dilated because of lack of stimulus through vasomotor centre; (2) that heart is slightly, if at all, influenced through inhibitory centre or nerves, and then always secondary to vasomotor centre. The latest, and by far the most thorough, experimental work has been done by Crile,[15] who made use of a large number of dogs in his researches into shock, and the means of controlling the blood-pressure. He ascribes, as the essential phenomenon in shock, a diminution of the blood-pressure due to exhaustion of the vasomotor centre. The pathology, if there be any, remains to be demonstrated. Parascandolo,[16] however, by experiments upon guinea-pigs, claims to have found certain changes in the spinal cord after shock. In case the animals died within an hour, he could demonstrate no changes. These changes, occurring in certain parts of the cord, affected the cell body, prolongations, nucleus and nucleolus, and consisted of chromatolysis, fragmentation, nuclear and perinuclear degeneration.

BIBLIOGRAPHY INDICATIVE OF THE RELATIONSHIP EXISTING BETWEEN TEMPERATURE AND SHOCK.

The special gravity of shock in the old is a recognized fact. C. H. Remy[17] states that the old have a special tendency to get cold and get warm with difficulty. "Burns and scalds, even if superficial, involving great area, are more prone to produce shock than those of limited area which extend deeply into the tissues."[18] In such a lesion the fall in body temperature is marked.

Demarquay,[19] from observations on thirty-eight wounded in French war, found that the temperature fell in every case from one to several degrees Centigrade, and that this fall was more marked in an osseous or articular lesion. The lowest observation did not go below 34° C. Death most often supervened before the thermometer attained 35° C. Observations were made upon men from twenty to fifty years of age. Temperature fall was more marked in men of forty than of twenty. When the temperature descended to 35° C., they died with or without an operation. In six penetrating bullet wounds of the abdomen the temperature fell rapidly to 34° or 35° C., and death resulted. Redard[20] states that in sixty soldiers wounded by fire-arms there was always a lowering of temperature. Of sixteen fatal cases temperature was always below 36° C., and ranged from that point down to 33° C., of which there were three cases. The average temperature of the fatal cases was 34.9° C. in the articular, bone, and penetrating wounds. Erichsen[21] remarks that in fatal cases of shock there may be a fall of as much as 6° F. McCormack[22] states that "A fall in temperature below 96° F. nearly always presages a fatal issue," and that the lower the temperature the more unfavorable the prognosis.

BIBLIOGRAPHY RELATIVE TO THE IMPORTANCE OF A NORMAL BODY TEMPERATURE.

Cohnheim,[23] speaking of the normal body temperature as 37.2° C., says, "For this is the most favorable temperature

as regards the activity of all the organs; all the body functions then take place most energetically." Schafer [24] likewise places it at 37.2° C. From this standard the normal physiological variation is only .2 to .3 of a degree. The necessity of such a slight variation is rendered more clear when we consider cell physiology a chemical process, and therefore the part that warmth plays in its proper activity. Edwards,[25] in a lengthy article, states, "Since the time of the Egyptians it has been recorded that warmth is the chief factor in producing development in eggs of warm-blooded birds, and that all the workers from Von Bear and Harvey down to the present have established an optimum temperature at 38° C.; also, that it has been shown that cold below 35° C., when not too intense or prolonged to destroy the embryo, retards or even suspends the process of growth during its application." The significance of this fact is pointed, for the cells of a bird and a human are of the same material, and multiplication is but one of the physiological properties of a cell. Carvallo,[26] as a result of numerous experiments upon the sartorius of a frog with the circulation intact, found that the muscle gave its minimum relative contraction at 25° C., and its maximum absolute at 37° to 38° C. He also found that the height and quickness in response increased per temperature increase. That cooling of common sensory or motor nerves deranges their functional activities is a fact so well known that it needs no comment.

In concluding the review of literature, special attention should be directed to the observation of White [27] and others to the effect that normally there is a wider range of temperature in animals than in man. Therefore we would expect a wider range in a pathological condition.

EXPERIMENTAL RESEARCH.

Series A.

Note.—In this series, after a control tracing was taken, the abdomen was opened and the intestines exposed. They were carefully spread out upon abdomen. No manipulation

was practised upon them. From time to time, at rather long intervals, the different surfaces of the intestines were exposed to the air to admit of more regular heat loss. In this series the shock which was produced was entirely dependent upon the simple exposure of the intestines.

PROTOCOLS. SERIES A. APRIL 2, 1903.

I. Black mongrel. Weight, 9 kilos. Blood-pressure, 144 millimetres.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	3.09	39	0	60	Intestines exposed.
2	3.11	39	+8	48	
3	3.13	39	0	..	
4	3.15	38.9	0	..	
5	3.17	38.9	+12	..	Veins dilated. Arteries full and bright red.
6	3.20	38.8	20	72	
7	3.24	38.6	40	..	
8	3.27	38.5	46	72	Marked arterial pulsation.
9	3.39	38	39	..	
10	3.42	37.8	49	80	Veins greatly dilated. Arteries greatly pulsating.
11	3.47	37.7	41	60	Anæsthetic minus.
12	3.52	37.6	46	..	
13	3.58	37.4	56	72	Veins more dilated and darker in color.
14	4.23	37	43	51	
15	4.31	36.9	67	..	
16	4.45	35.4	71	..	Respiration ceased; heart still beating.
17	4.55	35.2	101	..	Pressure gradually falls and heart ceased.

Time, 1.46. Temperature fall, 3.8° C.

(There was a very slight hæmorrhage incident to tear in carotid at point of cannula insertion.)

II. April 8, 1903. Black water spaniel. Weight, 12.8 kilos.

On administering a small amount of ether, animal suddenly stopped breathing, and was resuscitated with difficulty. On again giving anæsthetic, respiration again ceased. Breathing was re-established after four minutes of vigorous artificial respiration and the animal allowed to come completely out from influence of anæsthetic. The ether was again administered with great care, but the respirations became exceedingly rapid, short, and shallow. Animal was abandoned as poor subject and allowed to come from under anæsthetic. He recovered use of fore-legs first. Hind-legs remained paralyzed for a considerable time.

III. April 9, 1903. Black terrier. Weight, 6.9 kilos. Blood-pressure, 116 millimetres.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	3.50	37.2	0	36	Control tracing.
2	3.52	37.2	22	76	Intestines exposed.
3	3.56	36.9	36	..	Slight arterial pulsation.
4	3.58	36.5	30	40	
5	4.04	36.2	28	..	Marked arterial pulsation. Veins much fuller.
6	4.09	35.8	26	34	
7	4.20	35.5	30	28	
8	4.56	34.4	..	..	Clotting, which it is impossible to remove. This extends clear into the artery.
9	5.12	33.5	..	..	
10	5.27	33	..	..	
11	5.34	32.8	..	..	Injected eight cubic centimetres of 1 to 50,000 adrenalin solution into subarachnoid space.
12	5.43	32.6	..	..	
13	5.48	32.2	..	..	
14	5.57	32	..	..	Respiration ceased. Heart ceased at 5 58. Immediately injected ten cubic centimetres of 1 to 50,000 adrenalin in femoral vein; no effect.

Time, 2.07. Temperature fall, 5.2° C.

Autopsy.—Heart stopped in diastole. Left ventricle full of dark unclotted blood, which was darker than venous. Right ventricle also full, some clotting. Posted spinal canal and found adrenalin (colored with methylene blue) had travelled up subarachnoid space into floor of fourth ventricle. Some slight discoloration was present in lateral ventricles. There was discoloration of left ventricle from solution injected into heart.

IV. April 20, 1903. Black and white mongrel. Weight, 10 kilos. (Five grains of morphine previously injected.) Blood-pressure, 140 millimetres.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	11.00	35.4	0	..	Control.
2	11.30	34.4	30	15	Control.
3	11.34	34.4	40	15	Intestines exposed.
4	11.44	34	30	10	
5	11.47	33.9	34	..	Beginning pulsation of arteries.
6	11.51	33.8	56	12	Marked pulsation.
7	11.55	33.6	64	..	
8	12.03	33.2	..	11	Heart very irregular. Very marked pulsation.
9	12.12	32.8	56	..	
10	12.16	32.7	56	..	
11	12.20	32.6	54	..	
12	12.24	32.5	56	..	
13	12.27	32.4	44	11	

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
14	12.29	32.3	40	..	
15	12.32	32.1	44	..	
16	12.34	32	76	..	
17	12.38	31.9	98	18	
18	12.41	31.9	98	12	Arteries intensely congested and bright red.
19	12.49	31.7	72	..	
20	12.52	31.4	70	..	
21	12.56	31.4	84	..	
22	12.59	31.4	52	14	
23	1.04	31.3	82	..	Pulsation not so marked.
24	1.07	31.2	60	..	
25	1.09	31.1	76	..	
26	1.15	31	56	..	
27	1.18	30.9	54	14	
28	1.22	30.8	54	..	Pulsation still less. Veins very dark.
29	1.27	30.6	58	..	
30	1.29	30.6	60	..	
31	1.35	30.4	50	..	
32	1.38	30.2	56	12	
33	1.43	30.1	56	..	
34	1.46	30	54	..	
35	1.50	29.9	56	13	
36	1.53	29.8	60	..	
37	1.54	29.7	56	..	
38	2.05	29.4	70	..	
39	2.13	28.8	64	12	Applied cold towels.
40	2.24	28.5	72	..	
41	2.28	28.3	74	..	Intestines a dark chocolate color.
42	2.30	28.2	76	..	
43	2.37	28	74	..	
44	2.41	27.9	78	..	
45	2.43	27.8	84	..	Dog died; respiration ceased first.

Time, 3.13. Temperature fall, 7.6° C.

V. May 5, 1903. Black and white female bull-dog. Weight, 15.5 kilos. Old, but in good condition. Blood-pressure, 187 millimetres.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	3.41	38.6	0	43	Control tracing.
2	3.46	38.8	36	55	Intestines exposed and some arterial pulsation.
3	3.50	38.5	16	65	Arterial pulsation. Mesentery congested.
4	4.08	37.6	26	..	More pulsation.
5	4.12	37.5	30	60	
6	4.25	37.1	26	63	
7	4.39	36.4	36	..	
8	4.44	36.3	54	81	
9	4.54	36	64	..	Veins distended and darker in color. Pulsation more marked.
10	4.59	35.9	66	70	Same as No. 9.
11	5.08	35.8	80	..	Veins mediumly distended and dark. No arterial pulsation.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
12	5.16	35.8	94	71	
13	5.22	35.8	94	..	
14	5.29	35.6	100	56	Veins darker and fuller. No arterial pulsation.
15	5.35	35.4	104	..	
16	5.41	35	110	57	Intestines getting darker in color. Veins very dark and full. No arterial pulsation.
17	5.44	35	110	..	
18	5.49	34.8	116	54	
19	5.53	34.7	118	..	
20	5.59	34.6	116	..	Intestines very dark. Veins nearly black. No pulsation.
21	6.06	34.6	118	53	Same as No. 20.
22	6.12	34.3	120	..	Intestines chocolate color. No pulsation. Veins black.
23	6.21	34.2	122	42	
24	6.26	34.1	124	..	
25	6.33	34	124	..	
26	6.46	33.8	126	24	
27	6.50	33.8	126	..	
28	6.59	33.2	128	24	Veins black and intestines still a darker chocolate color.
29	7.07	33	130	..	
30	7.20	32.8	130	24	
31	7.27	32.7	132	..	
32	7.32	32.6	134	..	
33	7.39	32.4	...	..	Dog died. Heart ceased first, then respiration.

Time, 3.51. Temperature fall, 6.2° C.

CONSIDERATION OF EXPERIMENTAL EVIDENCE.

Temperature.—The evidence shows that in every case there was a gradual and uniform drop in temperature from the time the intestines were exposed until death resulted from shock. The curve of fall in every case was regular, and there was no acceleration or retardation in any part. This fall ranged from 3.8° C. in I. to 6.2° C. in V., giving an average of 5.7° C. The average normal temperature was 37.5° C., and the average temperature just before death was 31.8° C. There was quite a marked difference between the temperatures at which death ensued, which seemingly was partly accounted for by the variance in their normal temperature.

Time.—The time required for shock to produce death varied from 1.46 in I. to 3.51 in V., giving an average of 2.44.

Fall in Blood-Pressure.—While in all the cases there was ultimately a very great fall in the blood-pressure, the descent was neither regular nor continuous. From time to time the pressure would rise more or less gradually without external cause, remain so for a time, and then fall below the lowest point previously obtained. In V., however, after 1.10, the descent became continuous, though irregular in type. The character of the blood-pressure phenomenon is well shown by IV. In this experiment at observation 17 and 18 the pressure was at a lower point than that at which the animal died. It then recovered to a marked degree, and then again underwent the usual type of fall. The fall attained before death occurred varied from 84 millimetres in IV. to 134 millimetres in V., with an average of 106 millimetres.

Respiration.—The evidence shows that in two cases the tendency was for an acceleration of the rate up to what can be termed the midpoint of the experiment. In the other cases this was not evident. After this acceleration there was a retardation; the rate towards the end was in every case slower to a more or less marked degree than at the beginning. Marked irregularity is shown throughout. The average fall in rate was ten per minute.

Immediate Cause of Death.—In three cases the respiration was the first to cease. In one case the heart was at fault.

Observations on Mesenteric Vessels.—A. *Arteries.* In each case, either immediately upon exposing the intestines or in a very few minutes afterwards, pulsation could be plainly seen. As the experiment progressed, this pulsation would become more and more intense, until it could be seen a considerable distance away. This would then continue over a considerable period of time, and would then either, as in V., cease rather suddenly or, as in IV., very gradually.

B. *Veins.* The evidence shows that as the experiment progressed the veins became darker and darker in color until at the end they were almost black. Considering the degree of distention of the veins at different points in the experiments, the observations were by no means exact enough to base a

definite statement, but the impression conveyed, however, was that the distention became gradually greater as the shock increased.

Intestines.—In IV. and V., where observation was made, the intestines gradually became darker in color until, just before death, they were a rather dark chocolate shade.

SERIES B.

NOTE.—In this series, after a control tracing was taken, the intestines were exposed and spread upon abdomen. The dog was then immediately picked up bodily and placed in the bath-tub, containing normal saline solution at a temperature as near to that particular dog's normal temperature as it was possible to keep it. There was saline enough in the tub to cover the body and exposed intestines. The head of the dog was held above the water by a broad band running under the nape of the neck.

PROTOCOLS. SERIES B.

I. April 20, 1903. White mongrel, Weight, 12.8 kilos. Blood-pressure, 126 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	3	38.2	....	0	48	Control tracing.
2	3.12	38	....	+ 2	60	Intestines exposed.
3	3.20	....	38	+ 10	62	Dog transferred to bath.
4	3.30	37	37.5	30	46	
5	3.35	36.1	38	50	52	No arterial pulsation.
6	3.50	37	37.2	50	53	
7	3.57	36.8	36.8	62	..	No pulsation; no mesenteric congestion.
8	4.11	36.8	38	54	53	
9	4.22	36.2	39.5	86	..	
10	4.30	36.2	37.7	71	53	
11	4.39	36.1	38	89	..	No pulsation; no abnormal congestion.
12	4.48	36.1	38	85	45	
13	4.58	36	38	75	..	No pulsation.
14	5.04	36	39.9	85	55	
15	5.12	36	38	89	..	
16	5.22	35.9	38.7	91	57	
17	5.30	36	39.2	89	..	
18	5.38	37	38.5	89	55	No pulsation or mesenteric congestion.
19	5.45	....	....	89	54	Began pouring in cold water to reduce temperature of bath.
20	5.51	36.2	26	77	46	
21	6.00	34	26	95	44	Respiration and pressure ceased.

Time in warm saline, 2.38. Temperature fall, 1.2° C.

II. April 21, 1903. Black and white coach dog. Weight, 14 kilos. Blood-pressure, 102 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	1.53	38.6	....	0	30	Control tracing.
2	2.08	38	39	26	38	Intestines exposed. Transferred to bath. Stomach greatly distended and fluctuating; intestines are dark; fine adhesive bands are on mesentery.
3	2.21	37.8	38	24	42	
4	2.30	38	39	20	49	
5	2.38	38.1	38	26	55	
6	2.47	38.1	38	26	60	
7	3.02	37.9	36.5	26	49	No arterial pulsation or abnormal congestion of veins.
8	3.09	37.9	38	36	54	
9	3.19	37.9	38.3	46	67	
10	3.30	37.5	38.9	52	74	
11	3.35	....	....	..	38	Respiration failed first, numbering twenty before death. Dog died suddenly when pressure was exerted upon stomach to reduce its size (two times original). There is evidence of fibrinous peritonitis. On incision, stomach contained whitish, chyme-like material of very foul odor. A rough section of bone, three-fourths of a walnut in size, was found plugging pylorus (acute stenosis).

Time in bath, 1.37. Temperature fall, 1.1° C.

III. April 23, 1903. Young female brown terrier. Weight, 10.5 kilos. Blood-pressure, 112 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	12.17	37	....	0	51	Control tracing.
2	12.43	36	39.5	16	66	Intestines exposed. Transferred to bath.
3	12.49	35.6	39	32	64	No pulsation of vessels.
4	1.00	35.6	37.7	30	62	Slight pulsation.
5	1.08	35.6	40.3	30	..	
6	1.16	35.6	39.4	26	47	Pulsation rather marked.
7	1.21	36.8	38.5	19	47	Pulsation marked.
8	1.30	....	....	..	45	Clot in cannula.
9	1.48	35.3	36.4	24	49	
10	1.58	35.4	37	28	..	
11	2.07	35.8	39.4	18	56	Clot at 2.10.
12	2.34	35.7	36.9	36	77	Pulsation not so marked.
13	2.43	35.8	38.5	36	..	
14	2.48	35.9	37.6	30	67	Clot at 2.53.
15	3.25	36	36	18	74	
16	3.34	35.1	35.5	18	70	Medium pulsation.
17	3.43	35	35	10	..	Pressure rises and falls without external cause, allowing bath to cool.
18	3.50	34.8	34.4	14	69	
19	3.56	34.4	33.8	10	67	Clot formed deep in artery; impossible to remove. Killed by opening carotid.

Time in bath (before allowing to cool), 3.08. **Temperature fall,** 1° C.

IV. May 2, 1903. White and black female mongrel. Weight, 15.9 kilos. Blood-pressure, 118 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	1.28	37.8	....	0	32	Control tracing.
2	1.32	37.6	....	2	56	Exposure of intestines.
3	1.42	37.2	40	12	30	Transferred to bath.
4	1.51	37.2	39	8	33	No pulsation of arteries.
5	2.01	37.4	41	28	35	No pulsation of arteries.
6	2.10	37.2	39	26	..	
7	2.16	37.4	38.2	20	40	
8	2.25	37.2	40.2	20	34	
9	2.35	37.8	39	4	45	
10	2.47	37.8	38	18	30	
11	2.55	37.9	38.4	18	..	No pulsation; veins slightly darker in color.
12	3.06	37.2	37.6	18	34	Clot at 3.09.
13	3.31	37	36.9	52	38	No pulsation.
14	3.42	37	38.5	38	50	No pulsation.
15	4.03	37.8	36.7	26	50	No pulsation; clot interferes
16	4.13	37.2	37.4	22	46	No pulsation.
17	4.24	37	37.2	22	56	No pulsation.
18	4.31	37	36.3	22	63	No pulsation of arteries. Died at 4.45 from anæsthetic while clot was in cannula.

Time in bath, 3.03. Temperature fall, .8° C.

CONSIDERATION OF EXPERIMENTAL EVIDENCE.

The evidence can be more conveniently studied by the aid of the following table:

Protocol.	Original Temperature.	Final Temperature.	Temperature, Fall.	Average Bath Temperature.	Time in Bath.	Fall in Millimetres.	Respiration.	
							Original.	Final.
I.	38.2	37	1.2	38.1	2.38	89	48	55
II.	38.6	37.5	1.1	38.1	1.37	52	30	74
III.	37	36	1.0	38.1	3.08	18	51	74
IV.	37.8	37	.8	38.2	3.03	22	32	63

NOTE.—(Where water was allowed to cool, data is inclusive just to that point.)

Temperature.—The consideration of the evidence shows conclusively: (1) That the bath had a very marked influence upon preventing the fall in temperature; (2) that this influence was not sufficiently strong, however, to prevent a certain

degree of fall from the normal, although bath temperature may be higher than the normal body temperature, as in III. and IV. In every case the body temperature went below the temperature of the bath, with an average of 1.25° C. below. The temperature curve was irregular in character in all the cases, due, in all probability, mainly to the somewhat varying temperature of the bath.

Time.—The time consumed in the bath was in every case sufficient to allow of proper conclusions being drawn for use in certain comparisons which are to be made between A and B. The time varied from 1.37 to 3.08, with an average of 2.36.

Fall in Blood-Pressure.—Quite a wide variation was shown in the blood-pressure fall,—the maximum being 89 millimetres in I., the minimum, 18 millimetres in III., with an average of 45 millimetres.

Respiration.—In every case there was marked acceleration, the final rate in two instances being double the original. But the rate was extremely variable from time to time. The average increase at the end was twenty-five per minute.

Immediate Cause of Death.—Immaterial, because none were caused by shock.

Observations on Mesenteric Vessels.—A. *Arteries.* In three out of the four experiments there was no pulsation at any point in the experiment. In III., however, there was a varying degree of pulsation observed throughout.

Series C.

Note.—In this series, after the control tracing had been taken, the abdomen was opened and the intestines exposed. They were vigorously manipulated almost continuously from the beginning of the experiment until the production of presumably fatal shock, Series A being used as a guide to this condition. At this point the dog was transferred to the normal salt solution bath at a temperature which registered slightly higher than the normal body temperature. Manipulation was ceased and the effect of the bath noticed.

PROTOCOLS. SERIES C.

I. April 27, 1903. Brown female mongrel. Weight, 9 kilos; good condition. Blood-pressure, 126 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	2.25	37.8	..	0	55	Control tracing.
2	2.35	37.8	..	10	60	Intestines exposed. Some arterial pulsation.
3	2.42	37.5	..	20	39	Manipulation began.
4	2.48	37	..	28	..	B, 4 and 5, M = 12 millimetres; sudden fall and sudden rise; pulsation more marked.
5	2.54	36.4	..	30	47	Pulsation very marked.
6	3.01	35.9	..	26	..	Pulsation very great. B, 6 and 7, M = 26 millimetres; rather gradual fall and slow, gradual rise.
7	3.07	35.6	..	28	47	Pulsation very great.
8	3.13	35.5	..	30	..	B, 7 and 8, M = 20 millimetres; rather gradual fall and similar rise.
9	3.19	35.1	..	16	..	
10	3.31	34.5	..	16	47	
11	3.37	34.2	..	36	..	B, 10 and 11, M = 25 millimetres; slow fall and rather gradual rise.
12	3.42	34	..	44	43	Intense mesenteric congestion; pulsation extremely marked.
13	3.47	34	..	36	..	B, 12 and 13, M = 30 millimetres; rather slow fall and gradual rise.
14	3.54	34	..	40	..	B, 13 and 14, M = 24 millimetres; rather slow fall and very slow rise.
15	3.57	33.5	..	41	..	
16	4.04	33.3	..	42	43	
17	4.09	33.2	..	38	..	B, 17 and 18, M = 25 millimetres; gradual, slow fall with slow, gradual rise.
18	4.14	33	..	42	..	
19	4.20	32.9	..	46	52	
20	4.26	32.8	..	46	..	B, 19 and 20, M = 20 millimetres; very gradual fall and extremely slow rise.
21	4.34	32.8	..	28	40	Manipulation is very vigorous.
22	4.40	32.7	..	28	..	
23	5.06	32.8	..	20	37	
24	5.15	32.7	..	46	..	B, 23 and 24, M = 24 millimetres; extremely gradual fall and similar rise with imperfect recovery.
25	5.18	32.6	..	54	..	
26	5.39	32.4	..	44	39	B, 26 and 27, M = 36 millimetres; with same character as 24.
27	5.44	32.4	..	58	35	
28	5.49	32.4	..	59	33	B, 28 and 29, M = 14 millimetres; rather rapid fall and imperfect recovery.
29	5.56	32.4	38	59	34	Transferred to bath after 29; pressure fall = 80 millimetres.
30	6.10	33.8	40	54	46	
31	6.19	35.4	39	56	..	
32	6.24	35.5	39	50	..	Killed at 6.25 on account of clot deep in vessel.

Time for shock, 3.24. Time in bath, twenty-eight minutes. Temperature fall, 5.4° C. Rise in temperature, 3.1° C.

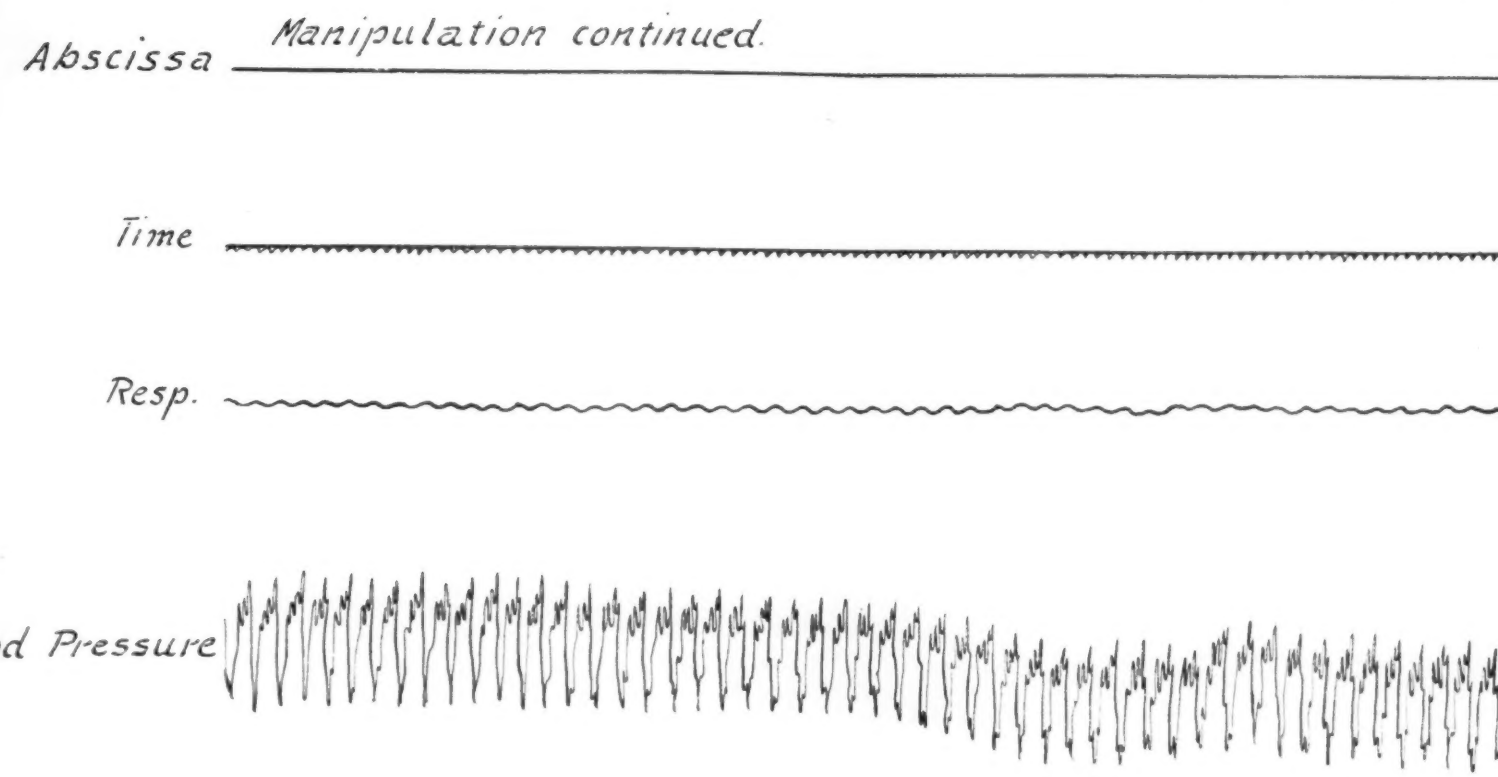
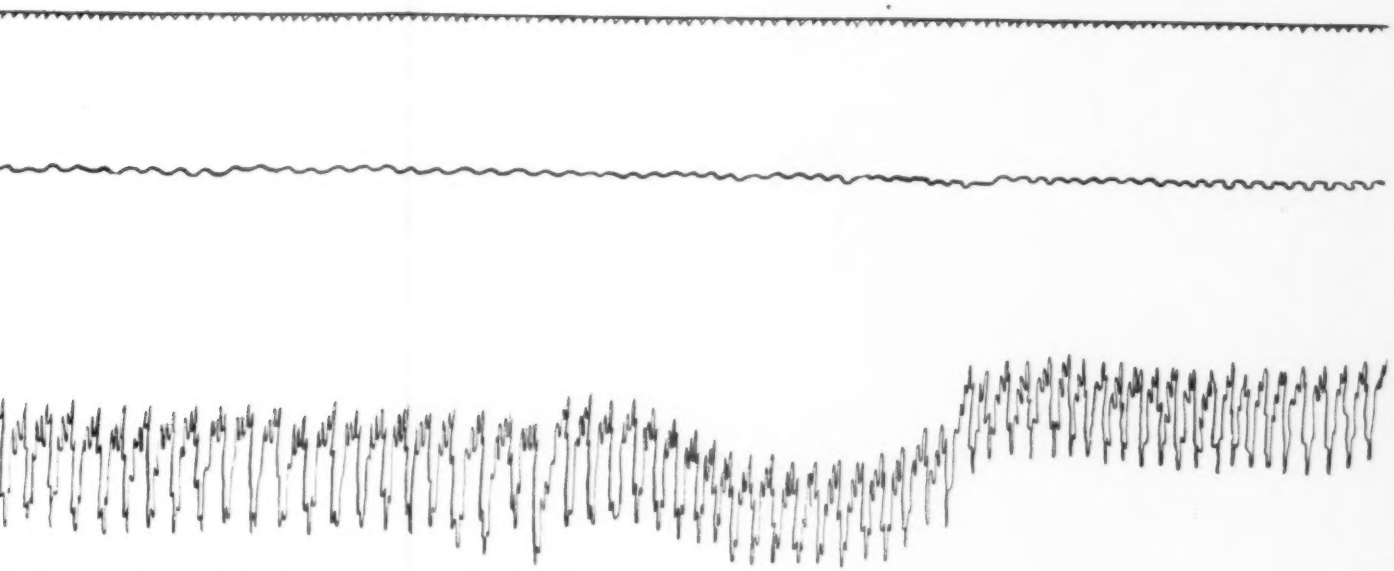


FIG. 2.—Note the sudden fall in blood-pressure incident to manipulation. Also that, although mani

pril 28, 1903.

Manipulation.



though manipulation is continued, the pressure regains its previous height.

II. April 28, 1903. Yellow and white mongrel. Weight, 18.5 kilos. Blood-pressure, 136 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	12.11	39.4	....	0	40	Control tracing.
2	12.18	39.4	....	+4	..	
3	12.25	39 3	....	18	44	Intestines exposed.
4	12.30	39.2	....	8	..	Pulsation of arteries. B, 4 and 5, M = 29 millimetres; sudden fall and sudden recovery.
5	12.39	38.8	....	10	38	Marked pulsation; veins full and dark.
6	12.48	38.4	....	16	..	B, 5 and 6, M = 24 millimetres; sudden fall and gradual recovery; very marked pulsation.
7	12.57	38	....	18	24	Very marked pulsation.
8	1.07	37.6	....	24	..	Very marked pulsation.
9	1.16	37.4	....	20	..	B, 8 and 9, M = 22 millimetres; sudden fall and gradual recovery.
10	1.23	37.3	....	16	24	Very marked pulsation.
11	1.31	37	....	22	..	B, 11 and 12, M = 28 millimetres; sudden fall and more gradual recovery. Great mesenteric congestion; veins distended and dark.
12	1.41	36.7	....	22	22	Pulsation extremely marked.
13	1.50	36.5	....	26	..	Pulsation extremely marked.
14	1.57	36.2	....	20	..	B, 14 and 15, M = 16 millimetres; sudden fall and slow return.
15	2.04	36.2	....	28	22	Pulsation extremely marked; veins darker; mesentery vivid red.
16	2.10	36	....	26	..	
17	2.19	35.9	....	30	21	Intestines dark brown in color.
18	2.27	35.8	....	36	..	B, 18 and 19, M = 20 millimetres; sudden fall and very gradual rise.
19	2.32	35.8	....	34	..	Veins black; pulsation slight; intestines chocolate color.
20	2.48	35.8	....	34	23	
21	2.56	35.4	....	36	..	B, 20 and 21, M = 15 millimetres; sudden fall and very gradual rise.
22	3.11	35.2	....	32	..	No pulsation; mesentery bright red.
23	3.22	35	....	40	25	Veins very black.
24	3.42	35	....	50	29	B, 23 and 24, M = 12 millimetres; sudden fall and more rapid recovery.
25	3.48	34	....	58	30	B, 24 and 25, M = 8 millimetres; rapid fall and quick recovery. Transferred to bath.
26	3.56	35.2	39	57	39	
27	4.05	35.7	38.5	54	..	
28	4.13	35.7	40.5	44	45	
29	4.19	36.6	39.5	44	46	
30	4.28	37.4	40.2	40	47	
31	4.42	37.4	41	30	38	
32	4.47	38	39.6	30	54	
33	4.56	38.1	39.9	25	48	
34	5.02	39.2	42.2	..	29	Anæsthetic + +; intestines a mottled chocolate color; veins black and full.

Total fall in temperature, 5.4° C. Rise in temperature, 5.2° C. Time, 3.29. Time in bath, 1.08.

III. April 30, 1903. White female bull-dog. Weight, 9 kilos. Blood-pressure, 100 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	2.10	39	...	0	62	Control tracing.
2	2.24	38.8	....	0	57	Intestines exposed; no pulsation. B, 2 and 3, M = 10 millimetres; sudden fall and quick recovery.
3	2.32	37.6	....	24	..	
4	2.41	36.8	....	42	69	Pulsation of arteries; B, 4 and 5, M = 16 millimetres; sudden fall and quick recovery.
5	2.50	36.1	....	34	..	Pulsation of arteries marked.
6	2.59	35.6	....	34	68	Pulsation of arteries marked.
7	3.07	35	....	36	..	B, 7 and 8, M = 16 millimetres; sudden fall and quick recovery.
8	3.18	34.2	....	38	..	Marked pulsation of arteries.
9	3.28	33.9	....	44	60	B, 8 and 9, M = 20 millimetres; slow fall and gradual rise, with irregularity following.
10	3.34	33.6	....	45	..	B, 10 and 11, M = 5 millimetres; rapid fall and slow recovery; no pulsation; veins dark and full.
11	3.43	33	....	50	49	Very fatal shock.
12	3.52	32.9	41	69	43	Transferred to bath.
13	4.00	33.9	39.2	46	49	
14	4.14	34.6	38	62	49	Ether + +; on account of extreme shock, ether seems to have increased effect.
15	4.21	35.2	40.5	48	40	
16	4.35	36	40	..	..	Died from anæsthetic.

Time for shock, 1.42. Time in bath, forty-three minutes.
Temperature fall, 6.1° C. Rise in temperature, 3.1° C.

IV. May 9, 1903. Female Boston terrier. Weight, 16.2 kilos. Blood-pressure, 156 millimetres.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	3.55	39.4	....	0	51	Control tracing.
2	4.02	39.3	....	+2	46	Intestines exposed. Veins full; slight arterial pulsation.
3	4.09	38.6	....	6	46	Takes anæsthetic badly.
4	4.17	38.6	....	36	..	B, 4 and 5, M = 8 millimetres; sudden fall and sudden recovery.
5	4.32	38	....	38	49	Veins less full; slight arterial pulsation; mesentery injected a bright red.
6	4.39	37.7	...	38	..	
7	4.51	37.2	....	42	55	B, 7 and 8, M = 16 millimetres; rapid fall and rapid recovery.
8	5.05	36.8	....	40	60	Extreme mesenteric injection; no arterial pulsation; veins not nearly so full.

No.	Time.	Rectal Temperature.	Bath Temperature.	Fall in Millimetres.	Respiration.	Remarks.
9	5.18	36.2	....	40	..	B, 8 and 9, M = 7 millimetres; rapid fall and slow recovery. Manipulation very severe.
10	5.32	35.8	....	32	57	Veins more distended and darker in color. Mesenteric injection more marked; no pulsation.
11	5.46	35	....	28	..	B, 10 and 11, M = 4 millimetres; sudden fall and medium recovery.
12	5.58	33.2	....	54	55	Veins extremely distended and very dark; no arterial pulsation.
13	6.06	....	38.4	70	..	Transferred to bath.
14	6.21	35	39	45	88	
15	6.33	36	38.5	41	77	
16	6.45	37	39.6	38	69	
17	6.56	37	39.6	26	..	Clot at 7.09; temperature still 37° C.; fall in millimetres is 24 millimetres. Killed by opening carotid.

Time for shock, 2.11. Time in bath, fifty minutes.
Temperature fall, 6.2° C. Rise in temperature, 3.8° C.

CONSIDERATION OF EXPERIMENTAL EVIDENCE.

Temperature.—A. Up to Point of Transferring to Bath, *i.e.*, presumably Fatal Shock.—The evidence shows that there was a gradual and uniform fall in the temperature from the time the intestines were exposed until the production of the presumably fatal shock. At no time was there a demonstrable tendency to acceleration or retardation. The fall varied from 5.4° C. in I. and II. to 6.2° C. in IV., giving an average of 5.77° C. The average normal temperature was 38.9° C., and the average temperature at which shock was considered fatal was 33.1° C.

B. Subsequent to Transferring to Bath.

TABLE SHOWING TIME RELATION.

Protocol.	Rise in Temperature.	Time in Bath.	Average Temperature of Bath.	Rise in Blood-pressure.	Fall attained in Shock.
		Minutes.		Millimetres.	Millimetres.
I.	3.1	28	39	30	80
II.	5.2	68	40	33	58
III.	3.1	43	39.7	21	69
IV.	3.8	50	39	44	70

It is evident that the bath, averaging .5° C. higher than the normal temperature, had a very marked effect upon raising the body temperature. In II., where the time in bath was greatest, the rise in temperature was the most pronounced. This suggested a certain relationship between the rise in temperature and the time consumed. Although not conclusively absolute, this relationship was found to vary from 9 minutes in I. to 13 minutes in IV. for each degree, with an average of 11.5 minutes per degree. This rise in every case was rapid in comparison with the primary fall and much more step-like in character. The average rise was 3.8° C. in an average time of forty-seven minutes.

Time.—The time necessary for producing presumably fatal shock varied from 1.42 in III. to 3.29 in IV., with an average of 2.41. The time in bath has been considered.

Blood-Pressure.—A. From Beginning of Experiment to presumably Fatal Shock.—The experimental evidence shows that ultimately in every case there was a very marked fall in the blood-pressure. But this fall was neither regular nor continuous. It was characterized by great irregularity. There were periods from time to time in which the pressure would, without external cause, exhibit a very marked rise, which would be sustained for a considerable time, and then show an irregular fall, reaching a point lower than any previously attained. This character of pressure is well shown by I. The irregularity, however, was not so marked in degree as in Series A. The fall of pressure attained when the impression given the observer was that the shock was fatal varied from 80 millimetres in I. to 58 millimetres in II., giving an average of 69 millimetres.

B. From Point of Transferring to Bath to Termination of Experiment.—The evidence shows that in every case there was a consistent and progressive rise in the pressure. This rise was in all cases rather irregular in character, while in III. there was one point (observation 14) of marked irregularity. The rise varied from 21 millimetres in III. to 44 millimetres in IV., with an average of 32 millimetres.

Respiration.—A. Up to the Point of Transferring to Bath,

i.e., presumably Fatal Shock.—The evidence shows that in three out of the four cases the respirations were markedly slowed, an average of 17 to the minute. In the fourth case there was an increase of 4 per minute in the rate. In every case a great variance in the rate was evident from time to time.

B. After Transferring to Bath to End of Experiment.—In three of the cases a marked acceleration, 15 per minute, was shown, while in the fourth case, after an acceleration of 6 per minute, the rate fell to 3 below shock-rate. There was every evidence that this was caused by excess of anæsthetic. Here, again, the variance in the rate was present from time to time.

Immediate Cause of Death.—Immaterial, because it was not caused by shock.

Observations on Mesenteric Vessels.—A. *Arteries.* The evidence tends to show that in every case after the intestines were exposed arterial pulsation was visible, either immediately or in a short time afterwards. In two cases it gradually increased until greatly marked, while in the other two cases an increase to any extent was not noticed. In all the cases, the pulsation, after remaining for a considerable length of time, gradually became less and ceased. An increasing mesenteric congestion was observed in three cases, which became very intense. This did not change when pulsation ceased, but remained throughout. (No observations were made after animal was in bath.)

B. *Veins.* In three cases, where observations were made, the veins became gradually fuller and darker in color as the experiment progressed. The color when fatal shock was present was nearly black. The distention in one case was extreme in degree.

Intestines.—In only one experiment was observation made upon intestines. In this case they gradually became darker in color until fatal shock, when they were a dark chocolate.

SERIES X.-C.

NOTE.—The following two experiments were intended for Series C, but, owing to circumstances which were unexpected (in V., to too great shock produced before transferring

to bath, and in VI. to sudden death from anæsthetic), they will be considered with Series A, to which they are similar, with the exception that manipulation is added.

PROTOCOLS. SERIES X.–C.

V. May 7, 1903. Black and white female mongrel. Weight, 10.8 kilos. Blood-pressure, 155 millimetres.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	2.42	39.4	0	..	Control tracing.
2	2.57	39	+4	..	Intestines exposed.
3	3.16	37.2	22	..	Veins distended; arteries greatly injected and pulsating.
4	3.36	36.3	26	35	M = 32 millimetres; quick fall and quick recovery.
5	3.53	35.7	28	64	M = 36 millimetres; quick fall and quick recovery.
6	4.12	35	26	..	M = 30 millimetres; more gradual fall and then gradual rise.
7	4.23	34.6	42	60	Veins much darker, less distended, no pulsation; intestines contracted and knotty. M = 18 millimetres; rapid fall and rapid recovery.
8	4.40	34	52	63	Veins very dark and not so full; no arterial pulsation. M = 6 millimetres; rapid fall with slow recovery.
9	4.53	33.8	60	60	M = sustained rise of 6 millimetres.
10	5.11	33.7	70	60	Veins extremely dark; no distention. No arterial pulsation; intestines flaccid. M = 4 millimetres; slow fall and quick recovery.
11	5.17	....	82	..	Transferred to bath at 39° C. Steady fall of pressure to base-line and death. Death due to too great shock first produced. Respiration ceased first.

Time for shock, 2.29. Total temperature fall, 5.7° C.

VI. May 4, 1903. White mongrel. Weight, 7.25 kilos. Poor subject. Blood-pressure, 118 millimetres.

No.	Time.	Rectal Temperature.	Fall in Millimetres.	Respiration.	Remarks.
1	2.35	37	0	43	Control tracing. Cannula slipped off, with marked loss of blood.
2	2.47	36.4	34	48	Second control.
3	3.02	36	+8	47	Intestines exposed; slight pulsation.
4	3.13	35	24	30	No arterial pulsation; veins dark and distended.
5	3.23	34.4	46	21	No pulsation; veins still darker; intestines a dark chocolate color.
6	3.30	....	..	..	Died from ether.
					NOTE.—Manipulation had no effect upon blood-pressure as far as sudden fall followed by rise was concerned.

Time, fifty-five minutes. Temperature fall, 2.6° C.

CONSIDERATION OF EXPERIMENTAL EVIDENCE.

Temperature.—In V., where the dog died from shock, the fall in temperature was gradual and progressive till 33.7° C. was reached, when death ensued, a fall of 5.7° C. Although in VI. the death was from ether, the experiment serves to illustrate again the gradual and progressive fall in temperature that is characteristic of Series A and C. The fall in VI. equals 2.6° C.

Time.—In case of fatal shock, time consumed was 2.29.

Fall in Blood-Pressure.—The evidence shows that in the case of death from shock the fall was irregular in character, but, with one exception, was continuous and reached 82 millimetres on transferring to bath. Then there was a steady fall to base-line and death. In the case of the death from ether, the pressure shows an irregular character, a very marked rise above the lowest point previously reached, sustained for some time, and then a drop below the lowest point previously attained. Drop just before excessive amount of ether was given was 46 millimetres.

Respiration.—In V. machine failed to record respiration during the beginning of the experiment, hence we have no means of comparison; but the impression given is that the respiration was not slowed to any appreciable extent, and was fairly regular in type. In VI. the respiration was markedly slowed, although irregular in type.

Immediate Cause of Death.—In the case of fatal shock, respiration ceased first.

Observation on Mesenteric Vessels.—A. *Arteries.* In both cases there was arterial pulsation which lasted for some minutes and then ceased.

B. *Veins.* In the case of death from shock the veins in the beginning were distended. As the experiment progressed, they gradually became less distended and darker in color, and at the end were not at all distended and nearly black. In the other case the veins were distended and became gradually darker.

Intestines.—Intestines became a dark chocolate in VI.

They became contracted and knotty in V., and at the end of the experiment became flaccid.

Note in Conclusion of Experiments.—Two deaths occurred under anæsthetic. (1) Series B, April 20. White and black mongrel; weight, 8.6 kilos; rectal temperature, 39.6; died just after control tracing was taken. (2) Series C, April 27. Brown water spaniel; weight, 15 kilos; died while being reduced to surgical anæsthesia.

Having considered the experimental evidence of each series separately, there remains yet to be taken up the summary of the experimental evidence of the three series combined.

SUMMARY OF THE COMBINED EXPERIMENTAL EVIDENCE.

Temperature.—Where no effort was made to keep the temperature up, Series A and C (to shock), the fall was gradual and continuous in every case; there was no acceleration or retardation in any part. From a careful comparison of Series A and C, the evidence shows conclusively that, since the average fall in Series A was 5.7° C. in 2.44 and in Series C, 5.77° C. in 2.41, the effect of the manipulation in Series C upon the temperature was absolutely *nil*. We may then consider: (1) That a fall of 5.7° C., with or without manipulation, leads either to death from shock or to a condition of fatal shock; (2) That the final point reached varies suggestively with the difference in the original temperatures.

Where an effort was made to keep the temperature to normal (Series B), the results show: (1) That the sustaining influence of the bath was very marked indeed, and only allowed an average drop of 1° C. per experiment extending over an average time of 2.36; (2) That this influence was not great enough to prevent a certain degree of fall from the normal in every case; (3) That in every case the body temperature went below the temperature of the bath to an average of 1.25° C.

Where an effort was made to raise the temperature, which had already fallen (Series C), the marked effect of the bath was again shown. With a bath temperature averaging .5° C.

higher than the normal body temperature, the average rise was 3.8° C. in 47 minutes, giving an average of 1° C. every 12 minutes.

Blood-Pressure.—A. Unmodified by Bath. (Series A and C to Shock.) The evidence shows: (1) That in every case in both series there was ultimately a great fall in the pressure; (2) That this fall was of an irregular character and not continuous, being characterized by periods of improvement which continued varying lengths of time; (3) That, on making a comparison between Series A and Series C (with manipulation), whose average time and average temperature fall were practically identical, although the clinical appearance of dogs in Series C showed them to be in very fatal shock, there was a marked disparity between the average fall in pressure in the two series. The fall in A was 106 millimetres., that in C, 71 millimetres. Therefore, the conclusion must be, since the time and temperature fall in both series are the same, that the severe manipulation practised upon dogs in Series C had the ultimate effect *not* of increasing the fall of blood-pressure, but of *sustaining* it to a marked degree.

B. Modified by Bath. I. Through Entire Experiment. Series B. The evidence shows: (1) That in every case there was marked irregularity in the blood-pressure throughout each experiment; (2) That in every case the pressure fell to a greater or less degree, varying from 89 millimetres to 18 millimetres, giving an average of 45 millimetres; (3) That, however, on comparison with Series A, where the average time and every other factor, except the temperature unmodified by bath, was the same, the average fall was far less, being as 45 millimetres in B to 106 millimetres in A. This, then, plainly demonstrates that the bath was a very potent agent in modifying the blood-pressure fall, although it did not absolutely prevent it.

II. After the Production of Fatal Shock. The evidence shows: (1) That in every case there was a progressive though rather irregular rise in the blood-pressure averaging 32 millimetres, which was then sustained. This, therefore, demon-

strates conclusively the powerful effect the bath had on the blood-pressure lowered in shock; (2) That the effect was not a transitory one, but one which was lasting and progressive in character.

Respiration.—A. Unmodified by Bath. (Series A and C to Shock.) The evidence indicates: (1) That in every case in both series there was a considerable variation in the rate from time to time; (2) That in all the cases except one, where accurate observations were made possible, the rate was more or less markedly slowed as fatal shock approached. In the one case there was an increase of four per minute. The average fall in rate in Series A was 10 per minute, that in C, 17 per minute; hence more marked in C, where conditions were the same, except that manipulation was practised.

B. Modified by Bath. I. Through Entire Experiment. Series B. The evidence indicates: (1) That in every case the rate was extremely variable from time to time; (2) That in every case there was a more or less marked acceleration over the original rate towards the end of the experiment, the average increase being 25 per minute.

II. After the Production of Fatal Shock. Series C. The evidence indicates: (1) That in each case there was a variation in the rate from time to time; (2) That in three cases there was a more or less marked degree of acceleration, averaging 15 per minute, towards the end of experiment; while in one case, after an acceleration of 6 per minute, the rate fell three below shock-rate. But there was every indication that this was caused by an excessive amount of ether.

Considering respiration, then, as an entirety, the conclusions arrived at were: (1) That manipulation of intestines led to a more marked fall in the rate than simple exposure; (2) That the bath not only prevented a fall in the rate of respiration, but led to an acceleration of the normal rate; (3) That the bath acted upon the rate, lowered in shock, as an accelerator in every case except one, where an overdose of ether modified it; (4) That the bath had no effect upon the irregularity in the rate exhibited from time to time.

Immediate Cause of Death from Shock.—In the five cases where death resulted from shock, the evidence shows that in four the respiration was the first to fail, while in one case the heart first gave out and ceased beating. Reasoning from this, it is evident that the primary failure is not limited either to the heart or the respiration, but may be either, although the tendency is to primary respiratory failure.

Observations on Mesenteric Vessels.—A. *Arteries.* The evidence shows: (1) That in every case in Series A and C (to shock) pulsation could be plainly seen, either immediately following exposure of intestines or in a very few minutes afterwards; (2) That it would continue for a considerable though varying length of time. During this period, in all the cases in A and two of the cases in C, the pulsation became gradually more and more intense. In the other cases in C, this augmentation was not noticed; (3) That in every case the pulsation then ceased either rather suddenly or very gradually; (4) That in three of the cases in Series B (modified by continuous bath) no pulsation was present at any point in the experiment, while in the remaining case there was a varying degree throughout.

B. *Veins.* The evidence shows that in Series A and C (to shock) where observations were made, the veins became darker and darker in color as the experiments progressed, until at the end (either fatal shock or death from shock) they were almost black. In regard to the distention of the veins at different points in the experiment nothing definite can be said, for the evidence is not complete enough to warrant a conclusion. The impression given, however, was that they became gradually fuller as the experiment progressed, with one exception, C, V, where distention became less as experiment progressed.

Intestines.—In two observations in Series A and in two in Series C, it was found that the intestines became gradually darker in color, until at death or fatal shock they were a rather dark chocolate.

The Effect of Manipulation upon the Blood-Pressure.—Series C.

NOTE.—The manipulation in each experiment was very severe. It was as near continuous as possible, being ceased only at the times the observations were made, and then begun immediately afterwards. The character of response has been tabulated sufficiently throughout each experiment to admit of definite deduction.

Experimental evidence tends to show: (1) That manipulation causes an immediate and more or less sudden fall in the blood-pressure, although this fall may be preceded, as in several instances, by a primary sudden rise. In one instance the effect was manifested in a rise which was sustained for some time. In another instance fall was followed by a very considerable rise above normal; (2) That, although the severe manipulation was continued, the pressure would recover more or less rapidly, and would be uninfluenced until manipulation was ceased and was commenced again. Then the same characteristic fall would be repeated; (3) That the amount of fall was an extremely variable quantity throughout the experiment. In three cases it seemed to bear absolutely no relationship to the point of progress towards fatal shock. In two cases the fall seemingly became less towards the production of fatal shock. The fall ranged from 4 millimetres to 36 millimetres, with an average of 16 millimetres in all experiments; (4) That the character of the fall and succeeding rise (the quickness of each) varied greatly in the several experiments and in each individual experiment. The general character of both the fall and rise was rapid in two experiments. In one the fall and rise were slow throughout, and this slowness was somewhat progressive in degree as experiment progressed. In two cases the characteristic type was a rapid fall and moderately rapid recovery. In one case the recovery was imperfect during the last three observations of the experiment, while in two cases irregularity in the pressure was manifested at the latter part of each experiment during manipulation; (5) That in all the experiments, with the one exception mentioned above, no progressiveness either in slowness or rapidity of fall or rise could be demonstrated as the experiment progressed.

In conclusion of the summary, two facts have been noted frequently during the experiments, and deserve mention: (1) That in the state of shock ether has an increased effect, and great care is necessary in its administration; (2) That respiration has of itself a sustaining power upon the blood-pressure.

CONCLUSION.

Shock must not be considered as due to the lowering or exhaustion of one bodily function, but as a composite condition embracing an interference with the normal height of the blood-pressure (lowering), an interference (lowering) with the respiratory act, and a marked fall in the body temperature. Of these, as shock increases in severity, the most uniform and progressive factor is the fall in temperature. That there is a relationship existing between the fall in body temperature and shock is evident by considering: (1) That in one series the fall in temperature *was* the *sole* cause of shock; (2) That where, by continuous bath, the temperature fell but one degree Centigrade (average), the respirations were increased instead of diminished, and the fall in blood-pressure was greatly lessened; (3) That by raising the body temperature previously lowered in shock, the respiratory rate was increased and the blood-pressure raised. This relationship may be thus expressed: (*a*) A sufficient fall in the body temperature *can* cause a decrease in the respiratory rate and a marked fall in the blood-pressure, which, together with itself, we designate as shock; (*b*) Conversely, a limiting of the fall limits the fall in pressure and prevents a fall in the respiratory rate. Therefore shock is limited or prevented. (*c*) Antagonistically, a rise of the temperature causes a rise in the blood-pressure and the respiratory rate (reduced in shock), with the result of a gradual amelioration of all the symptoms. Thus, of the three factors concerned, the temperature commands first place by its power of production, by its power of limitation, and by its power of amelioration of the composite condition,—shock.

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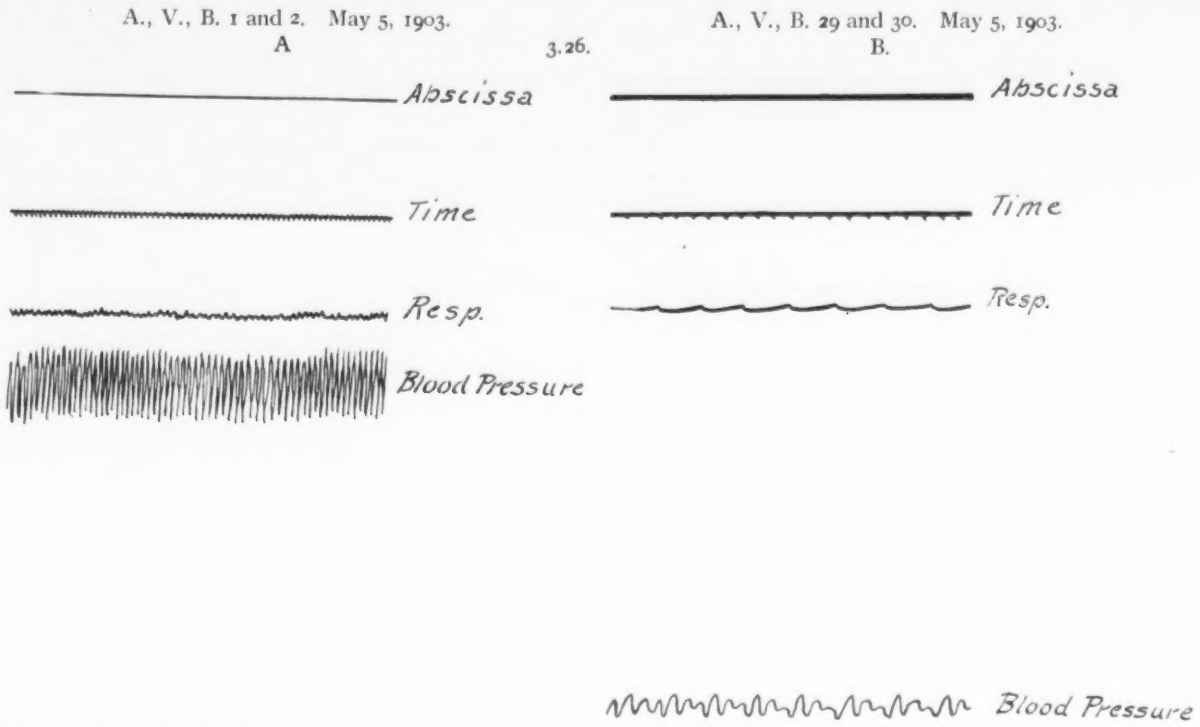

FIG. 3.—*Series A.* Showing the production of fatal shock by allowing the temperature to fall. Note the fall in blood-pressure and respiratory rate by comparing Sections A and B. A. Control tracing. Temperature, 38.8° C. B. Profound shock. Temperature. 32.8° C.

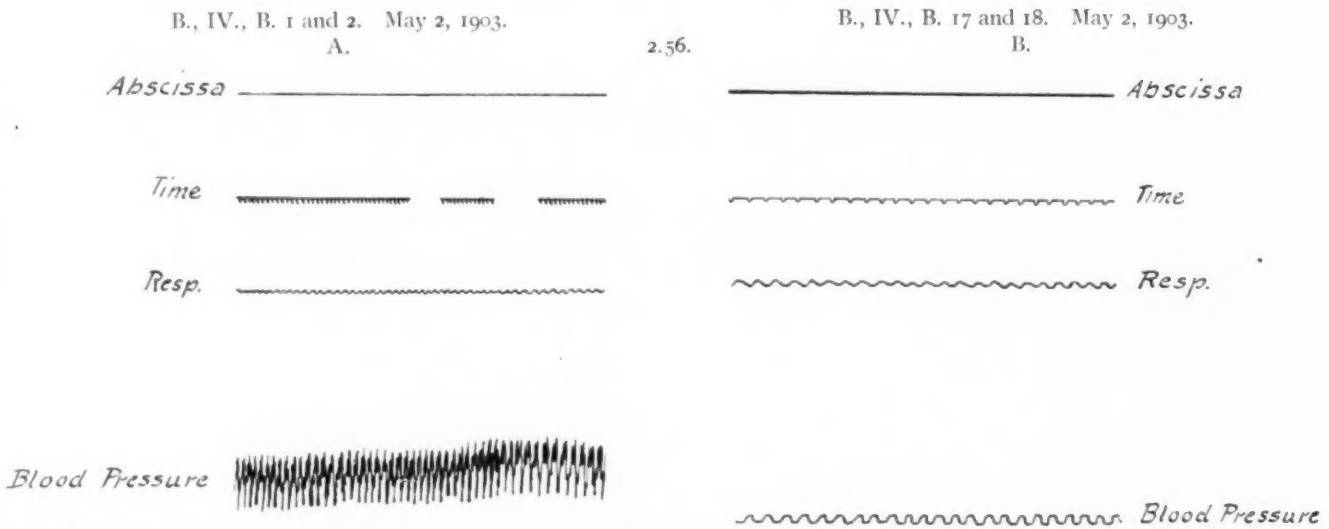

FIG. 4.—*Series B.* Showing the powerful sustaining effect of the bath—acting by keeping the body temperature up—upon the blood-pressure and respiration. Compare with Fig. 3. A. Control tracing. Temperature, 37.8° C. B., 2.56 later. Temperature, 37° C.

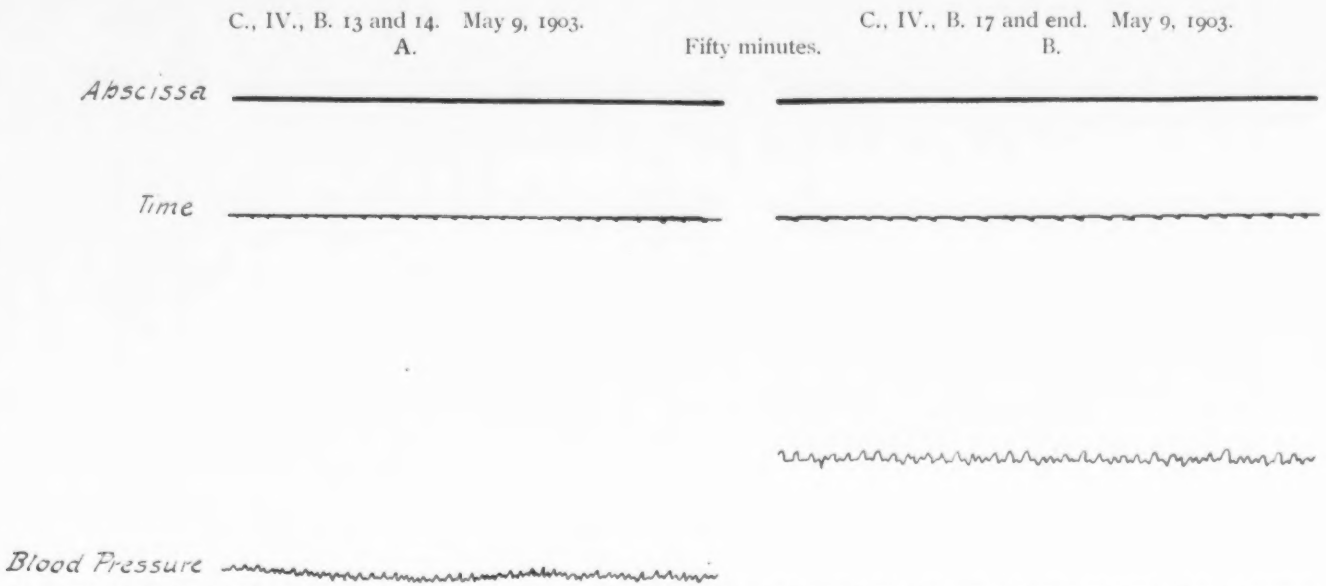

FIG. 5.—*Series C.* Showing the powerful effect the bath—by raising the body temperature lowered in shock—has upon the blood-pressure. Note the marked rise caused by bath. A. Profound shock. Temperature, 33.2° C. B. Amelioration of same. Temperature, 37° C. Time, fifty minutes.

ANOMALIES IN THE CIRCLE OF WILLIS.

WITH THE REPORT OF A CASE IN WHICH THE COMMUNICATING ARTERIES WERE ABSENT.

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ANOMALIES in the course and distribution of arteries may have a distinct surgical interest: the case here reported presents a rare deficiency in the vessels at the base of the brain of particular interest anatomically.

The patient was on the service of Dr. H. L. Burrell, to whom I am indebted for the privilege of reporting the case: I wish to thank Dr. Thomas Dwight for valuable suggestions, and Dr. Councilman and Dr. Mallory for allowing me to consult the pathological records.

The arteries at the base of the brain were described and figured with more or less accuracy by Vesalius [1] and by Casserius.[2] Thomas Willis [3] first recognized the importance of the communicating arteries and named them. The plates of Vieussens [4] and of Bidloo,[5] about contemporary with Willis, show the circle well; but Haller [6] was the first anatomist who described with precision the arterial circle ascribed to Willis, and who represented its branches accurately in his plates. Haller was disposed to detract from the fame of Willis's discovery; "Thomas Willisius ad Carotidum historiam non plurima addidit, neque circulum, qui ipsi tribuitur, melius Casserio pinxit." [7] The clearest and most exact plates of the Circle of Willis, among the older anatomists, are those of Vicq d'Azyr.[8]

It will be remembered that the blood supply to the brain comes through the carotid and vertebral arteries: "arteriæ sunt quatuor, scilicet duæ carotides et duæ vertebrales," says

Willis. As the blood comes directly from the heart,* a sharp bend in the course of both the carotids and the vertebrals as they enter the skull serves to retard the blood-current and preserve the brain from undue violence. The Circle of Willis serves further to retard the current; but its principal object is to insure an uninterrupted circulation to the cerebral hemispheres; the pons, medulla, and cerebellum being supplied by branches of the basilar artery and vertebrals. In consequence of the free anastomosis furnished by the Circle of Willis, it follows that obstruction on the cardiac side of the Circle does not interfere with the cerebral circulation; in dogs, it is not until all the four vessels leading to the Circle of Willis have been tied that symptoms of arrested cerebral circulation appear.[9] In man there have been reported cases in which both common carotid arteries were tied, with recovery.[10]

Sappey has termed the Circle of Willis a hexagon; Testut enumerates the vessels which form it, and urges that it is a heptagon; Duret says that ten, sometimes twelve, arteries enter into its formation, and it is best known as the polygon of Willis. It is formed in front by the anterior cerebral arteries, arising from the internal carotid on either side at the inner extremity of the fissure of Sylvius: they run nearly horizontally forward and inward above the optic nerve in the great longitudinal fissure between the cerebral hemispheres. Anteriorly, the circle is completed by the anterior communicating artery, a transverse vessel, usually two lines in length, connecting the two anterior cerebrals in front of the optic chiasma as they enter the longitudinal fissure. Laterally, the circle is formed by the posterior communicating arteries, arising from the internal carotid artery, on either side, before the latter divides into the anterior and middle cerebral arteries. The posterior communicating anastomose with the posterior cerebral arteries, which are formed from the bifurcation of the basilar, and complete the polygon posteriorly.

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* Le cerveau est le plus sensible des organes et il reçoit le premier de tous l'influence de la circulation du sang.—Claude Bernard. (Leçons sur les tissus.)

It is not within the province of this paper to describe the method of distribution of branches of the Circle of Willis in the central ganglionic system, nor to discuss the work of Duret,[11] Heubner,[12] Lucas,[13] Browning,[14] and others as regards the question of peripheral anastomoses in the cortical arterial system: Lucas demonstrated in the cortical system, communicating arterioles having a diameter of 0.25 millimetre. Given an occluded vessel distal to the Circle of Willis, the peripheral anastomosis in the cortical system is often not sufficient to maintain nutrition: the vessels in the central ganglionic system have no anastomoses, and are what Cohnheim has called "terminal arteries." As Dwight[15] metaphorically puts it, "this great outwork (the Circle of Willis) once passed, the citadel falls and softening results." The Circle of Willis comprises all the communications readily demonstrable between the two hemispheres.

The arteries forming the Circle of Willis vary greatly in size in different subjects, and on the two sides of the same subject.[16] Anomalies and deficiences are not particularly rare; the case here reported presented an anomaly which has not been noted previously; death resulted after ligature of the common carotid, owing to absence of all communicating arteries and consequent failure of collateral circulation.

The patient was an Italian laborer, thirty-five years of age; he had always been well, and his previous history is of no interest. He entered the City Hospital February 12, 1903.

Six weeks before, small swellings had appeared in each side of the neck; that on the right side increased very little in size; the one on the left grew very rapidly in all directions, and for a few days previous to entrance had caused some difficulty in breathing. He had no pain, and the swellings were not tender.

Physical examination showed a well-developed man, presenting nothing abnormal except the tumors in the neck and several small palpable inguinal glands. In the right side of the neck was a freely movable firm tumor, not reddened nor tender, about the size of a walnut. In the left side of the neck, extending from the ramus of the jaw to the clavicle, and from the mastoid behind to

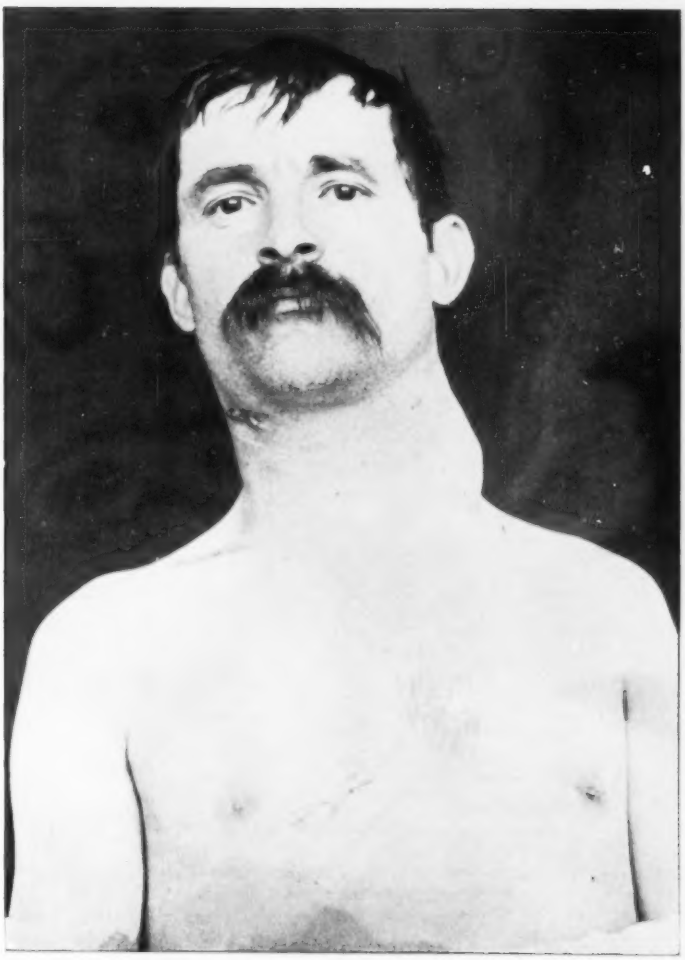

FIG. 1.—Lymphosarcoma of neck.

FIG. 2.—Showing vessels that form the Circle of Willis; degeneration of posterior communicating arteries to impermeable threads.

the median line in front, was a uniformly firm tumor mass (Fig. 1); it was slightly movable; the overlying skin was not reddened. The mass pushed the trachea slightly to the right.

The gland on the right side was removed for purposes of diagnosis; the report of the pathologist was Malignant Lymphoma (Lymphosarcoma).

February 19, 1903; operation, Dr. Burrell. On the left side of the neck incision beginning at the tip of the mastoid process, extending downward and inward to the sternal notch; from this latter point incision carried in a more or less horizontal direction along the border of the clavicle a distance of about three inches. Skin flap elevated and reflected, exposing the tumor. The mass was closely adherent to all the structures of the neck; the common carotid artery was developed and ligated; in freeing the tumor the artery was cut, necessitating another ligature, and about two inches of the vessel were removed between ligatures. The left lobe of the thyroid was removed with the tumor; a small mass was removed from below and behind the clavicle. The incision was closed with sutures of silkworm gut.

During operation the patient stopped breathing, and respiration was with difficulty restored and maintained. At the end of operation patient's condition was poor, but there was steady improvement for twelve hours, at the end of which time he apparently understood what was said to him, but could not be made to talk. Nineteen hours after operation, patient began to have periods of stertorous respiration, and to show spasmodic contraction of the muscles of the left side. The left pupil was much dilated; at times there was complete paralysis of the right side of the face and the right extremities. In the intervals between these attacks, the patient was semiconscious; the pulse was of poor quality, 132 to 140. He responded to supra-orbital pressure by contraction of the muscles of the left side.

Twenty-four hours after operation, the patient became unconscious, the respiration was Cheyne-Stokes in character; the left pupil was very much dilated, the right pupil remained about two millimetres in diameter; all the muscles of the extremities showed tonic contraction. There was profuse perspiration of the right side of the face, sharply limited by the median line. The patient died twenty-eight hours after operation.

The autopsy was done forty-one and one-half hours post-

mortem. Body of a well-developed, well-nourished white man. Marked rigor mortis. Slight lividity of dependent parts. Pupils equal and dilated five millimetres. On the left side of the neck, extending from the mastoid process downward and inward parallel to the sternocleidomastoid muscle and reaching to the sternal notch, is an incision thirteen centimetres long. An incision likewise begins at the sternal notch, extends outward along the border of the clavicle for a distance of seven centimetres. Both incisions are sewed with silkworm-gut stitches.

Peritoneal Cavity.—Surfaces smooth and glistening. No increase of fluid. Mesenteric lymph-nodes slightly enlarged. On section grayish white in appearance. Appendix six centimetres in length, free of adhesions, provided with mesentery throughout, and points upward and inward. Diaphragm reaches to the fifth rib on the left, sixth interspace on the right.

Pleural Cavity.—Free of adhesions.

Pericardial Cavity.—Surfaces smooth and shining. Pulmonary artery opened *in situ,* contains cruor clot and dark fluid blood. Normal amount of straw-colored fluid in cavity.

Heart.—Weight, 310 grammes. Measurements: Tricuspid valve, nine centimetres; pulmonary valve, seven centimetres; mitral valve, eight centimetres; aortic valve, 7.5 centimetres; left ventricle, 1.5 centimetres; right ventricle, 0.7 centimetre. Epicardium, myocardium, endocardium, and valves normal.

Fresh section shows: *Lungs* dark red in color, usual carbon markings. Lower lobes on section dark red; slight pressure brings forth considerable frothy fluid.

Spleen. — Weight, 110 grammes. Capsule dark purple in color, wrinkled. Substance dark red. Malpighian bodies not easily distinguishable. Trabeculæ not increased. Knife scrapes away very little pulp. *Gastro-Intestinal Tract.*—Normal throughout. *Pancreas.* — Appears normal. *Liver.* — Weight, 1640 grammes. Capsule reddish purple, smooth. Substance normal in appearance. *Kidneys.* — Weight, 330 grammes. Strip readily. Cortex easily differentiated from the pyramids. Glomeruli appear as minute grayish-white points. Fresh section shows: *Adrenals.* — Normal. *Bladder.* — Normal. *Genital Organs.* — Normal. *Aorta.*—Shows slight sclerotic changes. Bone marrow of tibia yellow and of normal appearance. Bone marrow of femur of a deep reddish chocolate color.

Scalp and *Calvarium* normal. *Dura* tense on both sides, somewhat tenser over right hemisphere. Arachnopial villi evident upon outer face of dura, especially upon right side, as low, dark red, resilient elevations, pea-size. Sinuses contain fluid blood and loose cruor clot. Dura strips readily, leaving parallel rows of congested villi, somewhat more extensively developed than normal, fore-and-aft. *Pia.*—Normal; coarse veins of sulci moderately injected, on the two sides evenly, but less prominent against the œdema of the left cortex. *Convolutions* of right hemisphere flattened, of left hemisphere bulging and soft.

Basal Vessels are without macroscopic trace of sclerosis. Posterior communicating branches of Circle of Willis are impervious fibrous threads, left 0.05 millimetre in diameter, right somewhat smaller. Anterior communicating branch absent. The pervious vessels are all empty, or contain a little cruor clot. Straight branches of the major arteries present in normal numbers (Fig. 2).

Brain weighs, after escape of insignificant amount of fluid, 1720 grammes. Hemispheres taken separately, after cutting through the peduncles, weigh, right hemisphere, 580 grammes; left hemispheres, 740 grammes.

When the brain is spread on a board, the left hemisphere flattens perceptibly out and bulges 0.5 centimetre beyond its fellow. It is also evident that a median sagittal section would fall 0.05 centimetre within the territory of the left hemisphere. There is an oval area of diffuse pink injection, thumb-nail size, upon the under surface of the left frontal lobe; this area is of the same consistency as the rest of the hemisphere, and the bright color quickly pales out in the underlying substance.

Cortex of left hemisphere boggy, darker, and slightly more translucent than substance of right hemisphere. White matter of left side gives a kind of "blanc-mange effect," in plain contrast with normal medullary appearance upon right side. Ventricles and ependyma normal.

Carotid artery above ligatures contains cruor clot.

Middle ears normal. Diploe of temporal bone red.

Anatomical Diagnosis. — Hypostatic congestion of lungs; slight arteriosclerosis; excision of the left common carotid artery for the space of about seven centimetres; œdema and softening of

left hemisphere; anomaly of Circle of Willis preventing collateral circulation.

The principal anomalies which have been reported will be here described under the head of each of the arteries forming the circle. Windle [17] found the normal arrangement in 119 out of 200 cases: in forty-three of these cases there was well-marked inequality in the size of the posterior communicating vessels.

The Anterior Communicating Artery.—Quain says it is double in 7 per cent. of the cases; this is its most common abnormality: of Windle's 200 cases, fourteen were double. Barbieri [18] reports twenty cases of abnormal cerebral circulation, in which he found the artery double once, single and abnormally large eight times, filiform twice, impervious once, entirely absent once, and normal seven times. Windle found it normal 159 times in 200 cases: incompletely double, *i. e.*, forked at one extremity, in six cases: absent in eight. In one case three communicating arteries were found. Barkow [19] mentions that the vessel may give off an accessory anterior cerebral; Windle found this present in nine cases. When the vessel is double, one is usually of normal size, the other very small.

The Anterior Cerebral Arteries.—According to Theile [20] the two vessels may be united into a single trunk, or the two may arise from one carotid, in which case the two posterior cerebrals arise from the other carotids. Lloyd [21] reports such a case. According to Bullen [22] either vessel may be replaced by two small trunks, or the vessel may be wanting, its region being supplied by branches of the other anterior cerebral. If only one vessel is present, it is usually the left; a third anterior cerebral is present, arising from the anterior communicating, in 4.5 per cent. of the cases, according to Quain; of Windle's [17] 200 cases, 181 showed normal anterior cerebral vesssels. In one case the vessel of the right side was absent, its area of distribution being partly supplied by small branches

from the corresponding vessel. In one case the right was twice the size of the left; in one case the two anterior cerebrals united to form a single trunk, which ran as such to its termination; in eight cases the two vessels united for a short distance, six times replacing, and twice accompanying the anterior communicating. Finally, an anomaly has been described, in which both the anterior cerebrals and anterior communicating were absent, and the two carotids united directly.[23]

The Middle Cerebral Arteries are the most direct continuation of the internal carotids. If the posterior communicant vessel arises from the middle cerebral, as is not uncommon, the middle cerebral artery forms part of the circle,—usually for a distance of four to six millimetres. If, on the other hand, the posterior communicating arises directly from the carotid (and this is the usual arrangement), that portion of the carotid from the origin of the post-communicant to its division into anterior and middle cerebrals may be regarded as forming part of Willis's circle. Meckel states that the two middle cerebrals not unfrequently arise from the right carotid, in which case the anterior cerebral comes from the left carotid.

The Posterior Communicating Arteries show many variations; often the vessel is so large that the posterior cerebral may be considered as arising from the internal carotid rather than from the basilar, to which latter it is connected by only a slender vessel. Quain says this occurs on the right side in 5.5 per cent. of the cases, on the left side in 4.5 per cent. Webber[24] reports such a case, in which the left posterior communicating vesssel was twice the usual diameter, and the left posterior cerebral half the usual diameter, before it was joined by the posterior communicant; in this case the middle cerebrals were normal. Absence of both posterior communicants seems to be rare; Meckel says it is one of the rarest anomalies. Of Windle's 200 cases, leaving out of consideration disparity in size (forty-three cases), the posterior communicants were normal in 175 cases. The vessel of the right side was absent in nine; of the left, thirteen; of both sides, in three. In

twenty-eight cases the right vessel was larger than the left; in fifteen the left was larger than the right.

The Posterior Cerebral Arteries.—According to Bullen, either vessel may be absent, may be a branch of the carotid system, may be replaced by a large posterior communicant, or be replaced by two small vessels from the basilar. Of Windle's 200 cases, 173 showed normal posterior cerebrals. The left was derived from the corresponding carotid nine times; the right had a corresponding origin eleven times. The two posterior cerebrals had origin on the same side of the brain,—one from the basilar and one from the carotid, three times. If the communicating vessels are absent, as in the case here reported, there is not usually complete lack of communication between the two arterial systems; there is commonly a certain slight anastomosis of small branches; such communication was, however, insufficient to preserve nutrition in this case.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting, June 1, 1903.

The President, RICHARD H. HARTE, M.D., in the Chair.

CASES ILLUSTRATING FRACTURE IN THE LOWER ANIMALS.

DR. W. BARTON HOPKINS exhibited for Dr. Charles B. Penrose and himself two specimens. The first was the femur of a deer which had been shot by Dr. Penrose, the bone showing the results of an old gunshot fracture.

Fractured Left Humerus of a Black-Tail Deer.—This animal was shot in the Sawtooth Mountains of Idaho during the last part of September, 1901. Horns had started, and the animal was therefore probably born in the spring of 1900, being at the time of death about fifteen or sixteen months of age. He was with two other deer, and appeared to get along as easily and as quickly as they did. There was no external mark on the skin to show the old wound. The skin was adherent over area about size of little finger-nail to the mass of callus. Tissues around seat of fracture were healthy, showed no signs of acute inflammation. A few drops of thick purulent material were found in a small pocket of fibrous tissue. Several small fragments of lead about size of No. 9 shot were found in fibrous tissue surrounding callus, and one free spicule of bone about one-half inch long by one-third inch wide, which was not united to humerus or to callus.

This animal had probably been shot the previous year in September, the open season, when a fawn. The uninjured right humerus was preserved for comparison. The animal was in as good condition as any of the eleven or twelve deer which were shot in that region.

The second specimen represents a gunshot fracture of the

tibia of an apparently healthy duck, of perhaps two or three months' standing. When the bird was killed, the wounds of entrance and exit were still open, the limb was very much swollen, and was shortened. There was no union of fragments. Preparation of the bones demonstrated excessive formation of callus about the seat of fracture.

Both of these specimens illustrate how motion at the seat of fracture produces excessive callus, the deposition at the latter being further increased if great deformity is present. In the one, the humerus of the deer, the mass of callus finally prevented motion and firm union resulted; in the other, the tibia of the duck, a like result would probably in time have occurred had the bird lived. Both specimens are interesting examples of gunshot fracture in the lower animals.

Dr. W. Barton Hopkins said that the specimen showed very firm consolidation of the fracture. Compared with the corresponding bone of the opposite side, it is seen that practically no rotation of the fragments has occurred. There is shortening, angularity, and marked overlapping, but no rotation. This may be attributable to the position of the humerus in the deer, which is well up against the thorax and supported by it.

Dr. John H. Brinton asked if any hypothesis could be hazarded as to the condition and possible position of the deer for the two or three weeks immediately following the injury. He then cited an instance of callus formation in a dog. Treatment was suggested a week after the animal had received a fracture of the leg. By that time an enormous amount of callus had been formed around the site of fracture. A plaster dressing was applied to immobilize the parts. In eight or nine days this became loose and a new one was supplied. It was then found that the excessive amount of callus had been almost entirely absorbed, this process taking place rapidly, as soon as the cast performed the work of the callus. This instance suggested that union in fractures of human bone may be more rapid than is usually thought. In replying to Dr. Brinton's question, Dr. Hopkins said that it must be assumed that an agile animal like the deer would do as a dog does under like circumstances,—go on three legs as long as there was pain in the injured limb. The probability in this case is that the deer kept his foot off the ground until healing of the fracture took place.

AN APPARATUS FOR MAKING TRACTION UPON THE KNEE FOR THE REDUCTION OF DISLOCATION OF THE HIP.

Dr. Oscar H. Allis exhibited an appliance which consists of two flanges that fit the thigh and a parallel bar on each side that can be pushed away from the inner flanged portion. The thigh is first bandaged, the apparatus applied, and several turns of bandage taken around the entire apparatus. By means of two thumb-screws on each side, the parallel bars are then pushed away from the flanges, and the bandages around them and the leg are made as tight as desired. If traction loosens the bandage, as it practically always does, a turn of the screws makes it tight again, this being the valuable feature of the apparatus. The bars carrying the flanges are prolonged in front and carry a transverse handle between their ends.

Dr. W. Barton Hopkins, on whose leg the apparatus had been applied for purposes of demonstration, said that after feeling it on his thigh he had one suggestion to offer regarding its improvement. He would prolong the handle about eight inches on each end and terminate it with knobs. This leverage would afford a powerful means of rotation when added to the purchase of the instrument on the leg.

Dr. Allis, in reply to the suggestion of Dr. Hopkins, said that the leverage exerted by one hand holding the ankle while the other made traction upon the instrument was sufficient, and was more safe than would be the powerful rotation afforded by the expedient suggested. The experience of many surgeons is that occasionally a case is found in which reduction of the dislocation is impossible. Bigelow has dealt with such cases by throwing the head of the femur in such a way as to tear the ligaments. With the apparatus exhibited, and the one hand manipulating the ankle, the bone can be teased back into its proper place in the same line in which it passed out and without the use of undue force and the risk of fracture.

AN ACCIDENTAL CURE OF A CASE OF PAPILLOMA OF THE BLADDER.

Dr. Orville Horwitz reported the case of a man who was first seen by him in consultation with Dr. Louis Breechman in

September, 1897. He was then sixty-three years of age. He stated that for two years he had occasionally noticed that he passed bloody urine, unaccompanied by any other symptom. The blood at first voided was small in quantity. As time went on the attacks of hæmaturia became very frequent, and the amount of blood lost was greater. Occasionally a good-sized clot would be passed. During the past three months there has been an increased frequency of micturition; the urine being voided about every three hours during the day and twice at night. This condition has never been attended with pain. The patient stated that at the outset of his complaint the blood was passed infrequently, that the urine was blood-stained, and had continued so for many weeks. He observed that the voidance of bloody urine was apt to follow over-exertion, constipation, or coition.

Examination of the urine showed it to be cloudy, alkaline, with a deposit of pus and phosphates, together with mucous threads accompanied by clots of blood. Albumen was present in large quantities. Examination by the microscope revealed pus and epithelial cells in large quantities together with crystals of hæmatobin. No casts were found.

The cystoscopic examination detected a large pedunculated papilloma in the vicinity of the left ureteral orifice. An operation was advised, which was positively declined. The hæmaturia abated under hygienic, local, and constitutional treatment. The cystitis decreased, and the individual enjoyed a period of three or four months of comparative comfort. Occasionally there would be a slight trace of blood in the urine, but the amount was so much lessened as to cause but little apprehension on the part of the individual, whose general health was excellent.

Whilst absent from the city during the summer, Dr. Horwitz's assistant was called to visit the patient, who was suffering with an attack of retention of urine caused by a blood-clot, the attack having followed a long walk in the country. Three similar attacks occurred within the next year, each having followed over-exertion. The first two were relieved with much difficulty; on the third occasion retention of urine had existed for fourteen hours. Every effort had been made to evacuate the contents of the bladder without success. The patient was in great pain, walking up and down the room, with the body bent well forward, so as to relieve the pressure on the bladder as much as possible.

A well-marked pyriform tumor existed above the pubic bone extending nearly as far up as the umbilicus. A catheter could be readily inserted by way of the urethra into the bladder, but, owing to the presence of the blood-clot, no urine could be evacuated. The over-curved catheter of Brodie, the blood catheter of Gross, and the evacuating tube of the Bigelow apparatus were each employed without relief. The patient positively declined to permit the use of either aspiration or suprapubic cystotomy. As a last resort, a small sized Thomson's lithotrite was introduced and an effort made to crush and churn up the clots in the bladder, emptying the contents from time to time by means of the evacuating catheter of the Bigelow apparatus, and washing out the viscus with a 5 per cent. hot suprarenal solution. After a manipulation for the space of an hour and a half, the bladder was finally emptied; irrigation with a hot suprarenal solution and continuous drainage were instituted by means of a soft catheter. Large doses of ergot were administered. There was no future trouble from retention of urine, which continued to be streaked with blood for about a week.

Two days after the relief by this manipulation, he began to void what he described as "large pieces of stringy flesh," which followed each act of micturition. An examination of the material showed it to be a portion of the villous growth which had evidently been crushed or torn off whilst attempting to break up the blood-clot. The débris continued to pass for about one week after the attack of retention, and was accompanied by acute cystitis; from this the patient gradually recovered, the inflammatory symptoms subsiding, the urine becoming clear, and all signs of vesical irritability disappearing.

Up to the present time the patient has enjoyed excellent health. There has been no return of either hæmorrhage or vesical irritability.

Unfortunately, after convalescence, a cystoscopic examination was not permitted, so that it can only be surmised that in attempting to break up the clot by means of the stone-crusher the tumor was either torn from its attachment to the bladder-wall or so injured that decay of the foreign mass took place, when it sloughed and was discharged with the urine.

INDEX TO SURGICAL PROGRESS.

GENERAL SURGERY.

I. The Distribution of the Arteries in Bone and Their Relation to Foci of Disease. By DR. LEXER (Berlin). The author, by skiagrams of bones taken from the new-born or very young children, denuded of periosteum and pericardium and injected with mercury, demonstrated that there are three sets of vessels. (1) The nutritive. At their origin, these vessels are often notably tortuous, and frequently are twisted around so that they run in a direction opposite to that in which they penetrated the corticalis. In the femur they are double and form a fine anastomosis in the medulla. Their branches reach to the ends of the diaphysis,—the metaphyses as Kocher calls these regions, where they are met (2) by a number of vessels penetrating the bone from the exterior, which distribute themselves in a tangle of branches against the cartilage and in part penetrate the epiphysis. These metaphyseal vessels are important in that they supply the territory which is the favorite site of tuberculous foci. (3) The epiphyseal vessels run from all sides into the bone nucleus, curve here to run to the articular cartilages or to the epiphyseal line, which they penetrate to meet the metaphyseal vessels. Thus the epiphyseal line gets perforating vessels from both sides. After studying well prepared specimens, it is evident that the sites where tuberculous foci are most commonly and suppurative foci most rarely found are those where one would naturally suppose that infected emboli would be swept. Emboli brought in by the nutritive artery are stopped in the metaphysis, those brought by the metaphyseal vessels in the epiphyseal line, those brought by the perforating vessels either in the epiphyseal line or in one of the terminal vessels which turn towards the articular

cartilage, and in this last case the wedge-shaped sequestrum is formed.

In the phalanges, metacarpal and metatarsal bones the nutritive artery quickly divides in numerous small branches; hence in the short tubular bones the diaphysis is the favorite site for tuberculosis.

The vertebræ are pierced by two large arteries from behind which penetrate to the middle of the bone or further. These correspond to the wedge-shape tuberculous foci which lie with their base forward. In the ribs there is a long, narrow, nutritive artery which runs to the cartilage junction, where it meets a vessel from the perichondrium. This is the site of the typhoid metastasis.

In the pelvis one sees how, if the branch going to the region of the cotyloid cavity becomes occluded by an infected embolus, the typical necrosis of the ilium and cotyloid cavity must result as described by König. The base of this sequestrum is directed towards the acetabulum, its apex outward and backward. The author concludes that all focal lesions in the bones which appear in striking relationship with the vascular distribution must be in relationship with the arteries, *i.e.*, must be referred to bacterial clumps or infected emboli. Infarcts only appear where terminal arteries exist. That the dissemination of tuberculosis by means of emboli is commoner than in the case of suppurative inflammation may perhaps account for the different degree of frequency in which certain locations are affected in these diseases. That in the young the bones are most commonly the seat of infection by emboli is explained by the great vascularity of their bones.—*Proceedings of the German Surgical Congress of 1903.*

II. The Antiseptic Action of Iodoform. By Dr. B. Heile (Breslau). Why does iodoform prove a good antiseptic in the clinic and in the laboratory lag behind all other antiseptics in virtue?

Heile's investigations show that when mixed with tissue juices

in *the absence* of oxygen iodoform becomes decomposed in three to five days, and that it now kills both staphylo- and streptococci, while under the same circumstances neither the tissue juices nor the iodoform alone have any effect. Of the body juices, that from the liver decomposes iodoform most powerfully, that from the brain or from fat least powerfully. Granulation tissue acts similarly to juices from organs, and tuberculous granulation tissue seems to have the most intense decomposing power. The degree of decomposition was found by the quantitative test for iodine, Corresponding to the antiseptic action of iodoform is the degree in which iodine is set free. The antiseptic action is, however, not due to the free iodine, since iodine is set free in the presence of oxygen, and iodoform is no longer an antiseptic when oxygen is present. Further, iodine, in the form of tincture or in solutions of KI or NaI, of much greater concentration than can be obtained by the decomposition of iodoform, is not antiseptic.

The author thinks it most probable that the decomposition of iodoform sets free di-iod-acetylene (CHI-CHI). This is very powerfully bactericidal, and is rendered inert by oxidization. These experimental findings correspond with clinical experience. Iodoform has much value in cavities, but none in superficial wounds. In internal organs, viz., liver and kidneys, iodoform is most powerfully decomposed, so powerfully, in fact, that it sometimes acts not merely as an antiseptic, but as a caustic.

The author concludes that iodoform is truly one of our best, if not the best, of our antiseptics.—*Proceedings of the German Surgical Congress of 1903.*

III. The Action of Local Irritants and Applications of Heat; Experiments on the Eye. By Dr. K. Wessely (Berlin). The bactericidal action in hyperæmia has an important place among the various factors which give benefit in the Bier method of treatment. But the bactericidal value of the *combined* transuded fluids alone has been studied, while in this the essential bactericidal material is mixed with various other factors, such as

carbonic acid, alkalinity, leucocytes. Wessely endeavors to solve the problem as to what rôle is played by the "anti-bodies" of the serum. In his work he produced mild degrees of hyperæmia by the use of irritants and heat. The question he proposed to investigate was, "Under the influence of hyperæmia, do the anti-bodies of the serum escape in greater quantities into the tissues?" The eye is a favorable structure in which to experiment, since the aqueous humor is easily obtained for investigation.

Local irritation (subconjunctival injections of salt solution, mechanical irritation, etc.) give rise to hyperæmia of the inner vessels of the eye, especially those of the ciliary body, and the result of this is a profuse effusion of albumen into the aqueous humor. Normally, the aqueous contains only $^1/_{40}$ per cent. of albumen, but after irritation, as above, the albumen rises to 1 to 2 per cent. Warm applications (50° to 60° C.) to the closed eyelids give similar results.

In artificially immunized animals he found that the corresponding anti-bodies were not present in the aqueous to any extent if the eye was not irritated, but that they appeared in numbers immediately after hyperæmia was produced. Thus, in animals immunized against typhoid the aqueous of a hyperæmic eye had ten to twenty times greater agglutinative power than that of the unirritated eye; in animals previously treated by injections of blood, the aqueous only dissolved blood-corpuscles if the eye had been irritated. Not merely agglutinine and hæmolysin escape into the aqueous under such circumstances, but antitoxin, bacteriolysine, and precipitin do likewise.

The increase in anti-bodies is always proportionate to the increase in albumen. Similar results were obtained in experiments on the fluids of the cornea.

From such experiments it seems clear that local irritation and warmth promote the increased effusion from the vessels of albumen and anti-bodies, and that this accounts for the curative value of hyperæmia.

IV. The Dangers of the Trendelenburg Posture. By PROFESSOR DR. KRASKE (Freiburg i. B.). Kraske acknowledges the value of this posture, but speaks of its dangers when used in certain circumstances. In two cases of suprapubic cystotomy (one for a large calculus, one for multiple papillomata) in which it was used, there was a fatal increase of existing myocarditis. Chloroform was used in neither case, and the loss of blood was minimal. Kraske thinks that the posture caused increased hydrostatic pressure and a flow of blood from the inferior vena cava sufficient to occasion an acute, irreparable dilatation of the feeble heart. In two cases Kraske saw intestinal obstruction follow immediately suprapubic lithotomy done in Trendelenburg position. Both these cases were in fat men. He concludes that the position should be discarded when serious myocardiac disease is present, and when it is believed that the omentum, mesentery, and epiploic appendices are loaded with fat, the posture should be employed with caution and for as short a time as possible,

TRENDELENBURG doubts the correctness of Kraske's conclusions as to the cardiac cases. He has never seen ileus follow the use of the position, but admits the possibility. The posture is not of much value in those whose bellies are loaded with fat. Trendelenburg has noticed gastric hæmorrhage after the use of the position.

V. EISELSBERG (Wien) saw apoplexy occur four days after operation with elevated pelvis. He always lowers the table as soon as possible. He has only seen gastric hæmorrhage in cases in which pelvic elevation was used.

KÖNIG (Berlin) warns against pelvic elevation in cases of abscess.

LAUENSTEIN (Hamburg), when he uses the Trendelenburg posture, always lowers the patient to the horizontal position and spreads out the omentum before closing the belly.

KÜMMELL (Hamburg) never saw ill results from the use of the posture, and does not believe that it may give rise to ileus.—*Proceedings of German Surgical Congress of 1903.*

HEAD AND NECK.

I. Traumatic Defects of the Skull and Their Closure. By Dr. Bunge (Königsberg), Bunge has investigated the results in twenty-two cases of skull injury which were treated in the past seven years. Kocher and Berezowski believe that no harm results from the non-closure of defects in the skull, and that harm follows their closure, especially if at the time of operation increased intracranial pressure was observed. In the Königsberg clinic aseptic cranial defects are always closed primarily, even if intracranial pressure happens to be increased. The following cases were traced:

13, open cranial defects.

5, defects closed primarily.

3, defects closed by secondary operations.

1, defect closed spontaneously.

The ultimate results were:

Cases of cranial defects left open.

4, developed traumatic epilepsy.

3, were well.

6, had various troubles, *e.g.*, flashes of light, giddiness, headache, faintness. The troubles were worst when intracranial pressure was increased by coughing, bowing the head, etc.

Cases in which the defect was closed by reimplantation of the bone at the time of primary operation. In none of these was there the slightest trouble.

Cases of secondary closure of the defect. In one of these epilepsy was present before the injury, and operation had no effect thereon. In two cases symptoms were cured by the closure. The other cases were free of trouble.—*Proceedings of the German Surgical Congress of 1903.*

II. The Surgical Treatment of Non-Traumatic Jacksonian Epilepsy. By Dr. F. Krause (Berlin). In non-traumatic

epilepsy surgical intervention is only proper in cases where the "irritation" is localized in some definite section of the sensomotor region.

Krause's cases are the following:

(1) Girl, sixteen years. For four years, Jacksonian epilepsy. Attacks begin in left half of face. Much anæmia. Operation, November 16, 1893. After trephining and opening dura, the lower face centre was found by the use of the faradic current. Here there was a large cyst, which was freely incised and drained. Recovery from epilepsy has endured nine and one-half years, and the mental development has become normal in a most astonishing manner.

(2) Girl, fourteen years. Up to five years of age normal. Then "fits" and mental degeneration began, and she became an imbecile. The spasms began in the left side of the face, passed to the left arm and leg. Operation on January 13, 1902, revealed a thick, white radiating scar in the facial region. Excision of this resulted in complete cure of the spasms, which has lasted one and one-half years. There has been marked mental and slight but distinct physical development.

(3) Man, thirty years. Healthy up to sixteenth year. Then severe nephritis, left hemiplegia with hemianopsia. Ten years later epileptic attacks, beginning in left forearm and accompanied by loss of consciousness. Operation, October 15, 1903, revealed chronic leptomeningitis in arm centre. Excision of centre. Recovery.

(4) Man, twenty-three years. In fourth month of life a single "fit." The right extremities remained weakened, otherwise development went on normally. From the thirteenth year, epilepsy, beginning in right hand and forearm. Loss of consciousness. Operation, February 19, 1903, showed a subarachnoid cyst. Recovery.

In none of these cases could pressure on the skull or elsewhere initiate an attack; epileptogenous zones were absent. There

were no cranial points of departure for sensible auræ. In none of the cases had there been any trauma. The skulls were normal. The affected centres were located and the skull opened sufficiently. The openings were about six or seven centimetres square. In each case the dura must be reflected; only thus could the presence of foci be made certain. In all the cases reported, the dura appeared healthy, and in one case (the fourteen-year-old girl) it pulsated normally.

In the man of twenty-three the dura only pulsated in the anterior half of the opening in the skull, and in this region there was found the most marked changes in the pia and brain. In the two other cases the dura appeared to be under great tension, and there was no pulsation.

The presence of normal dural pulsation does not permit the omission of laying back the dura and exposing the brain. When one finds sufficient changes to account for the symptoms, the operation ends with their removal or correction. When the anatomic changes causing the epilepsy are not evident on exposure and inspection, it is necessary to clearly define the brain area from which the epileptic spasms originate. This is done by faradic stimulation. At the place thus discovered one punctures or incises the cortex to disclose any subcortical lesion, such as was found in one of the cases reported. It is only after failure to find such lesions that it is permissible to exercise the apparently unaltered cortical area supposed to be at fault. No cortical area can be determined from consideration of its anatomic relationship; it must be found by direct faradic stimulation.

BRAUN (Göttingen) stated that the reports as to permanent cure are apt to be deceptive. In a case operated on by himself in 1890, and kept within reach, the patient always claimed to be well, and the result was so published in 1896. Since 1902 the patient has again had severe epilepsy, and it has been discovered that he concealed some previous seizures.

KÜMMELL (Hamburg) has only seen transitory improvement. In his last thirty cases there were no seizures as long as perma-

nent drainage was kept up, but as soon as the cannula was removed there was recurrence.

JOLLY (Berlin) admits that excision of affected cortical centres result in improvement, but in the majority of cases, at least, this is not permanent.—*Proceedings of German Surgical Congress of 1903.*

III. Treatment of Facial Paralysis by Nerve Transplantation. By DR. HACKENBRUCH (Wiesbaden). Hackenbruch reports the case of a girl of eight years who suffered from facial paralysis for seven and three-fourths years. The operation consisted in the implantation of two-thirds of the spinal accessory nerve into a split in the facial. After four and one-half months there was improvement; after nine months the child could voluntarily draw the right angle of the mouth outward. Encouraged by this result, the author, in a case of infantile spinal paralysis, implanted one-third of the tibial nerve into a longitudinal split in the peroneus nerve, which was totally paralyzed. Three months *post operation* there was some improvement, especially as regards *equinus.*

KÖRTE (Berlin) showed a patient in whom, one and one-half years previously, he anastomosed the peripheral stump of the facial nerve to the hypoglossal with much benefit. The muscles of the cheek and angle of the mouth are actively mobile, the orbicularis oculi weakly mobile, and the frontal muscles immobile. The accessory nerve is better as a graft than is the hypoglossal.

DOLLINGER (Budapest) warns against dividing the accessory nerve before it goes through the sternomastoid, as an irremediable paralysis and atrophy of that muscle may result. He recommends division of the nerve as distal as possible, and bringing it upward as a graft.

IV. The Subcutaneous Excision of Tuberculous Glands from the Neck and Submaxillary Region. Report of 100 cases. By DR. DOLLINGER (Budapest). Dollinger has in eleven years

operated in the above manner on 100 patients. Through an incision skirting the hairy scalp, practically all the neck glands may be extirpated, provided they are not too adherent. In this location no noticeable scar is left. The operator takes his place behind and above the head of the patient and uses an electric head-lamp. An assistant supports the head, and moves it freely in any desired direction.

Nerves and vessels are pushed aside, and the packets of glands removed by dissection with the finger or elevator. If a gland bursts or is torn by forceps it does not infect the wound, provided the extravasated material is promptly washed out. After removal of the glands the wound is cleaned, drained, and sutured, all under the control of the light. The hæmorrhage is strikingly scanty. If infection follows, a director is passed into the wound and pus is evacuated by some two millimetre incisions, which leave no observable scar.

Dollinger's results have been excellent. In conclusion, he remarks, "This operation demands great care and much skill on the part of the operator, and hence I believe will never attain popularity. However, in well selected cases the results are so complete and the absence of scar so appreciated by the patient, that it deserves careful consideration and will be established."

KÖNIG (Berlin) said the operation is proper when the glands are movable, but out of place when they are softened and adherent. The latter have no longer a capsule. The danger of recurrence is great, as, by the subcutaneous method, some glands are certainly overlooked.—*Proceedings of German Surgical Congress of 1903.*

JOHN F. BINNIE (Kansas City).

CHEST AND ABDOMEN.

I. Heart Suture following Injury. By DR. WOLFF (Danzig). Since the first cases of suture of the heart published in 1896 by Farina and Rehn, thirty-nine cases have been reported.

The author of this article reports three cases operated upon by Barth, of Danzig. Owing to the rarity of this class of cases, it will be of some interest to give a brief outline of them.

Case 1 was a man, twenty-eight years of age, who was stabbed over the region of the heart, and entered the hospital in collapse. The wound of entrance was enlarged, and the knife found to have penetrated the right pleural cavity and right edge of the pericardium. One inch each of the fifth, sixth, and seventh right costal cartilages was resected close to the sternum, as well as the xiphoid and about one inch of the sternum itself. A wound two centimetres long was found in the pericardium; two small clots were removed from the pericardial cavity, and the heart exposed. In the right ventricle was a wound two centimetres long, situated four centimetres above the apex, from which a small quantity of blood escaped. The heart was fixed by a loop of silk passed through its apex, and then three silk sutures were inserted to close the wound. The pleural and pericardial wounds were sutured, only a small strip of gauze being inserted at one angle. The patient died upon the fourth day. The autopsy showed that the knife had severed one of the large trabeculæ of the right ventricle, and had divided the tricuspid valves completely. The entire pericardial cavity was found to be filled with fibrin.

Case 2 was a suicide, a man, twenty-eight years of age, who had stabbed himself three times in the fourth left intercostal space, three centimetres from the left sternal border. He entered the hospital in collapse, with a left-sided pneumothorax. A horse-shoe-shaped incision was made, beginning at the junction of the fourth right rib and sternum, and carried over to the fourth and fifth left ribs, and across again to the right border of the sternum. Barth resected the costal cartilages of the fourth and fifth left ribs and part of the sternum. Both left pleura and left side of the pericardium were found to be wounded, the wound in latter being half a centimetre long. This was enlarged, and clots were removed from the pericardial cavity, following which the pulse

improved. A wound of the left ventricle, half a centimetre from the coronary artery, was found, from which hæmorrhage had ceased. The heart was turned to the right, and the wound closed with three silk sutures. The wound in the pericardium was closed entirely, without drainage. The patient recovered.

Case 3, a man, twenty-two years of age, was stabbed in the left mammary region. He entered the hospital very pale, and with a wound three centimetres above and to the inner side of the left nipple. This wound was four centimetres in length, and ran obliquely towards the ensiform process. There was a left-sided pneumothorax. The heart tones were weak, and upon opening the thorax the left fifth costal cartilage was found to be severed and the sixth cut into. There was also a wound of the pleura. Barth resected one and a half centimetres of each of the above cartilages. It was found that the internal mammary artery had also been cut, and this was ligated. A wound was found in the right ventricle near its junction with the auricle. It was three-quarters of a centimetre in length, and blood still escaped from it. It was closed with five silk sutures. The wounds in the pericardium and pleura were both sutured. The external wound was tamponed down to the pleura. The operation was followed by considerable dyspnœa and by a right-sided pleurisy with effusion.

Wolff has collected forty-two cases, with seventeen recoveries (40.4 per cent.). Of the forty-two cases, the injury affected the right ventricle in fourteen; the left ventricle in nineteen; the apex in five; the left auricle in one; the coronary artery in one; site not mentioned in two. Wounds in the left ventricle are most favorable for healing, because the thick muscle favors closure of the wound. It has been found that one coronary artery can be ligated with impunity. In thirty-seven of the forty-two cases the left pleura was also wounded; in three the right pleura, and in two there was no injury of the pleura. In thirteen cases the cause of death was a purulent pericarditis or pleuritis. Forty-one of the cases were stab wounds, and one was a bullet wound. The latter usually die before any surgical interference can be attempted.

In these cases of bullet wound there is usually a wound of exit on the posterior aspect, which makes suture impossible.

His conclusions are, in regard to bullet wounds, that they are better left to be treated expectantly.

In regard to the diagnosis of stab wounds of the heart, one is assisted by the position of the wound, by the collapse, and anæmia. The size of the external wound is no criterion of that of the internal. There may be signs of hæmo- and pneumopericardium. The former is characterized by peculiar characteristic splashing synchronous with the pulsations of the heart, and by feebleness of the heart tones. Pneumopericardium shows itself by abnormal tympany over the cardiac area. The pulse varies. It may be weak or it may be good. In the majority of cases, however, it may be scarcely palpable. Indications for operation are cases with severe primary hæmorrhage and hæmopericardium. There is always danger of secondary hæmorrhage in non-operated cases. Even if they heal without suture, they are liable to be followed by an aneurismatic dilatation of the scar.

As regards the technique, it is necessary to expose the heart fully by resecting the ribs. One need not attempt to avoid opening the pleura, because in the majority of cases, as stated above, it is involved; and it has been found that if the pericardium is opened suddenly without such a pleural wound, it causes a foamy condition of the blood in the pericardium. The best method is that of Giordono, to follow the wound and remove whatever tissue is necessary to expose the heart freely. The best suture material is silk, and the knots can be best tied during the diastole. It is better not to drain the pericardium, on account of the danger of carrying the infection inward, and it is only advisable to drain when infection or uncontrollable hæmorrhage is present.—*Deutsche Zeitschrift für Chirurgie,* Band lxix, No. 1.

DANIEL N. EISENDRATH (Chicago).

II. Operative Treatment of a Stab Wound of the Right Auricle. By DR. SCHWERIN (Berlin). The patient sustained

a stab in the chest on May 2, 1902, and was admitted to hospital three-fourths of an hour later. He was pulseless. Camphor injections and transfusion of salt solution had no effect. In the fourth intercostal space there was a wound six millimetres in length, with no escape of blood. Cardiac dulness extended to beyond the middle of the sternum.

Resection of the fourth and two centimetres of the fifth rib. The perforated left lung was firmly united to the sternum. Incision of pericardium. As the right heart was rolled up under the sternum, a stream of blood the size of a lead-pencil spouted forward in a slight curve. The heart was pulled forward by a traction thread passed through its apex, and in this manner a wound in the right auricle became visible. Digital compression and interrupted silk sutures. Pericardium and musculature sutured. Tamponade of the former and of the pleura. Recovery complicated by pyopericardium, empyema, and pneumonia. Patient now works as a locksmith without any symptoms.

Noll (Hanau) reported a case of gunshot wound of heart as follows: Girl, seventeen years, injured September 10, 1902, by revolver of seven millimetres caliber. Was seen one and one-half hours after injury in a condition of great respiratory distress. Respiration, 30; pulse, 74; but every four minutes four beats were missed. Cardiac dulness small, laterally indistinct. Over the middle of the upper portion of the left lung percussion note tympanitic; over the lower part dull. Cardiac tones clear, though a persistent peculiar bruit was audible.

From the physical signs and the direction of the wound, dangerous hæmorrhage from a cardiac wound was diagnosed. The heart was exposed. The wound traversed the fifth intercostal space, the pericardium, and the anterior wall of the left ventricle. The heart was steadied by a Péan forceps applied just above the coronary artery. Suture without difficulty. Drainage of pericardium with sterile gauze (removed in twenty-four

hours). Circumscribed empyema. Recovery in twenty-eight days.

During more than six months the patient has remained well. The author thinks that extensive resection of the thoracic wall is unnecessary and dangerous in such cases. Resections of portions of one to three ribs and traction of the divided pericardium into the wound give ample room for all purposes.—*Proceedings of the German Surgical Congress of 1903.*

III. Cardiolysis and its Indications. By Dr. L. Brauer (Heidelberg). A year ago Brauer published a method for the treatment of chronic adhesive mediastinopericarditis. In this disease the heart, pericardium, and the great vessels become attached to the neighboring structures (sternum, anterior and posterior mediastinum, diaphragm, and lungs) by bands of adhesions. According to the position and consistence of these bands various symptoms arise. Often the cardiac movements are communicated to the neighboring organs, or there is obstruction to heart action and its evacuation from the great vessels.

Brauer observed three such cases in which were present the following conditions. Varying amounts of pleural indurations, subjective and objective signs of cardiac insufficiency, obstructive hepatic cirrhosis with ascites, dyspnœa, in one case cyanosis, and signs that in every systole the heart retracted the chest wall. Such conditions are fatal, sometimes because of coexisting myocarditis, but principally because the heart cannot keep up such persistent overwork.

Would it be possible to lighten the cardiac work by section of the ribs in appropriate places?

Professor Petersen and Dr. Simon operated according to the author's ideas. The three cases all improved satisfactorily. The œdema, dyspnœa, cyanosis, and ascites diminished. The third patient, after showing essential improvement, died from bronchopneumonia.

SIMON (Heidelberg) added a short description of the operation performed. Local anæsthesia was attempted but failed, so that chloroform and subsequently ether were administered. In the first case, operation was confined to resection of ribs, but in the other two cases a portion of the sternum was excised four to five centimetres in width. To do this, a flap of skin and muscle, with its base to the right side, was reflected. On the left side two or three ribs were resected, and the sternum divided with a saw above and below the part to be removed. The isolated portion of sternum was removed, its posterior layer of periosteum with it. The removal of the periosteum is absolutely necessary to avoid reformation of bone. This act of the operation is very difficult, as the periosteum is firmly adherent to the heart.

Perfect hæmostasis is necessary. Simon thinks that the immense benefits which he has seen accrue from the operation ought to make it more frequently adopted.

PETERSEN (Heidelberg) advises that the first step in the operation consist in the excision of two or three ribs, after which one may judge if sternal resection is requisite. The periosteum must be removed. Disappearance of ascites occurred most marvellously.—*Proceedings of the German Surgical Congress of 1903.*

IV. Resection of the Thorax in Old Tuberculous Complete Empyema. By DR. RINGEL (Hamburg). Ringel reported three cases of the above, of which two are cured and one is recovering.

(1) Man of sixty-eight, developed a total empyema of the left pleural sac subsequent to caries of the ribs. Resection of the eleventh to sixth ribs, of the scapula up to its spine, and of the intercostal soft structures. This was accomplished in three sittings. The lung was decorticated. Recovery ensued after several plastic operations (Hautlappen-Plastiken).

(2) Man of twenty-two; metapneumonic; total empyema

of left side. Resection of eleventh to third ribs and scapula in two sittings. Recovery.

(3) Girl, twenty-eight. Total tuberculous empyema of left pleura. Resection of almost the whole of the eleventh to second ribs with the soft parts and scapula in two sittings; decortication of the lung. Recovery, except for a defect the size of the palm in the axillary line near the diaphragm.

Ringel uses Schede's U-shaped incision, as it gives the best view of the cavity, and permits of complete removal of the sclerosed intercostal tissues. Removal of the lower triangle of the scapula is always necessary (although this to some extent disturbs the function of the arm) when the empyema extends to the dome of the pleura. The scapula should be separated from its muscles, etc., which after its removal help to fill the pleural cavity. Decortication of the lung is very dangerous under some circumstances, and may generally be omitted. It is, however, essential in tuberculous empyema, because only thus is it possible to remove all the disease and to obtain surfaces which are capable of adhering. Concomitant disease in the opposite lung contraindicates resection.

JORDAN (Heidelberg) has operated on eleven cases. Recommends Schede's flap and combines with it decortication. Resection of the scapula is to be avoided if possible because of impaired arm function. In cases of tuberculous fistula the operation is to be adopted with reserve.

v. BÜNGER (Hanau) has operated on eight cases after Schede's method. Three cases were tuberculous, one of which died and two recovered. He has seen a case of *double* pneumothorax from gunshot wound, with general emphysema, recover after the application of an occlusive dressing and the use of oxygen inhalations.

REHN (Frankfort) considers Delorme's operation (decortication of the lung) neither easy nor without danger. He has seen cerebral embolism and bronchial fistulæ follow it.

PERTHES (Leipzig)) stated that it is possible to distinguish those cases of old empyema which are suitable for treatment by continued suction drainage from those in which resection is required, by means of measuring the expansibility of the lung. One determines (1) the size of the empyema cavity by filling it with fluid, and then (2) aspirating it and measuring the amount of fluid removed. If the amount of fluid removed by aspiration equals, or nearly equals, the amount introduced, *i.e.*, if the walls of the cavity come together when it is aspirated, then the case is suitable for suction drainage.

GARRE (Königsberg). Tamponade in pneumothorax is only of value when the lung is uninjured. Otherwise, it is preferable to open the thorax freely and establish an artificial pneumothorax.

KÖNIG (Altona). In Delorme's operation (decortication) it often suffices to split the indurated tissue down to the lung.

FRANKE (Braunschweig) saw the lung lacerate after pneumopexy.

RINGEL (Hamburg). Resection of the scapula is not always dispensable. To do the operation always in one sitting is dangerous. Delorme's operation is only suitable in tuberculosis.—*Proceedings of the German Surgical Congress of 1903.*

V. Recurrence of Hypernephroma in the Bronchial Lymph Glands. By DR. P. CLAIRMONT (Wien). The anatomical specimen shown was from a patient operated on ten years previously by Billroth for a right-sided kidney tumor. The kidney was removed. The right pleura was opened at the operation. The patient remained well until August, 1902, when he developed pulmonary symptoms,—dyspnœa, hæmatemesis, fever. In March he was admitted to the clinic, when there was found dulness both anteriorly and posteriorly over the lower portions of the right lung. In front and superiorly there was a tympanitic note and weakened respiratory murmur. Septic fever persisted.

Microscopic examination of some expectorated tissue shreds was negative. By exploratory puncture, some mucopus was found. In spite of the evacuation of an abscess in the indurated lung (due to bronchiectasis), the patient died.

At the autopsy an egg-sized tumor was found in the lymph glands at the bifurcation of the trachea. The tumor broke into both bronchi, completely closing the right one. On examination the tumor proved to be a hypernephroma. Since no relation exists between the kidneys and bronchial lymphatics, and hypernephromata can be disseminated through the blood-vessels, it is to be assumed that the right pleura was infected when opened during the nephrectomy ten years before; that the cells were absorbed, carried by the lymph stream, and deposited in the glands. Under unfavorable circumstances, these cells grew slowly to form a tumor after the lapse of ten years.—*Proceedings of the German Surgical Congress of 1903.*

VI. Anatomical and Clinical Researches in Gastric and Intestinal Carcinoma. By Dr. W. Petersen (Heidelberg). One hundred gastric and 200 intestinal carcinomata were examined. The anatomical work was done by Colmers, the clinical by the author in collaboration with Schüller, Werner, and Küpferle. Gastro-intestinal cancers as opposed to skin cancers most commonly grow in a unicentric fashion. Progressive cancerous degeneration was not observed with certainty in the lymph glands lying next the tumor.

The unicentric growth is shown by

(1) The continuity of each cancerous nodule one with the other (evidenced in serial sections).

(2) The method of invasion of glands by the cancer. There is always a sharp line of demarcation between the cancerous and the healthy cells. In no place was there any cancerous changes in the latter.

(3) The frequent occurrence of pure interglandular growth in which there was no progressive degeneration of the surroundings.

Because of this unicentric growth, Petersen concludes,—

(1) As to histogenesis. The margins of gastro-intestinal cancers are not suited for the study of histogenesis, since in unicentrically growing tumors growth, not histogenesis, is found here.

(2) As to etiology. The character and method of the unicentric growth of gastro-intestinal cancer is hardly compatible with the parasitic theory.

(3) In practical surgery, when recurrence takes place, such is in the vast majority of cases direct, *i.e.*, it is continued growth of parts of the tumor which have not been removed.

This being true, the exact recognition of the anatomical routes for the spread of such cancers becomes of doubled importance.

Gastric cancers spread most commonly inside the stomach wall, while intestinal cancers, on the contrary, infiltrate the walls and soon the neighboring tissues. The pylorus does not form any precise rampart against gastric cancer.

Recurrence being almost always due to incomplete removal of tumor, completeness of removal must be the remedy against recurrence.

The author has observed regeneration of cancer cells in skin cancers, and believes the same occurs in the gastro-intestinal variety.

Near gastro-intestinal carcinomata numerous cells are found, of which it is impossible to say with certainty whether they are carcinomatous or not.

The author believes that, especially in gastric carcinomata, more carcinoma cells are destroyed naturally than has been supposed. He also thinks that recurrence takes place in various organs in the following manner:

(1) Organ recurrence, most common in stomach.

(2) Gland recurrence, most common in lip or penile carcinoma.

(3) Cellular tissue recurrence, in rectum.

(4) Metastatic recurrence, stomach, mamma.

In conclusion, the author gives a few statistics from the Heidelberg clinic.

(1) Rectal carcinoma:

In 248 cases, mortality 13 per cent.

Permanent cure, 18 to 20 per cent. Thirteen patients lived over ten years.

(2) Gastric carcinoma:

(*a*) Gastro-enterostomy, 214 cases. Early mortality, 35 per cent. The last 100 cases, 18 per cent. Life prolonged four to five months. Marked decrease in suffering.

(*b*) Resection. Fifty-seven cases. Mortality in first twenty-four cases, 35 per cent.; in last thirty-three cases, 17 per cent.

Of the thirty cases operated on more than three years ago, eighteen survived, and of these seven still live. The four longest survivals are twelve, eleven, five, and four years.

Resection is now more practised than it was because

(1) Resection is not more hazardous than gastro-enterostomy. Twice as many patients die from pneumonia after the latter than after the former operation. The removal of the decomposing cancerous tissue appears to be of great value.

(2) The prospect of radical cure is much greater than was thought. The stomach and duodenum must be excised as widely as possible.

(3) Even when recurrence takes place, resection prolongs life on an average about nine months, as opposed to the four to five months of its rival.—*Proceedings of the German Surgical Congress of 1903.*

VII. Peptic Ulcer after Gastro-enterostomy. By DR. BRODNITZ (Frankfort a/M.). Brodnitz showed a specimen obtained from a patient operated on three and three-fourths years before death for pylorus stenosis. Operation was anterior gastro-enterostomy. After a protracted period of health, colicky pains

began, and a tumor the size of a cherry-stone developed in the middle of the scar. There was no relation between the pains and meal-time. Operation showed the tumor to be caused by a large ulcer of the jejunum opposite the anastomotic opening. The ulcer was adherent to the parietes. Resection of a part of the stomach, including the anastomotic opening and of a portion of the afferent and efferent loops of jejunum. Healing by primary intention. After nineteen days, after violent sneezing, a gastric fistula suddenly formed, but this closed after eight days of rectal feeding; good health was now maintained for five months, when there developed an infiltration the size of a mark (twenty-five cents) near the cicatrix, and nightly pains. The gastric contents showed 1.8 per cent. free hydrochloric acid. Under treatment for ulcer the pains disappeared, but the induration persisted. From the literature, Brodnitz could collect only fourteen cases of peptic ulcer.

He formulates the following conclusions:

(1) Up to the present time peptic ulcer has only been observed after gastro-enterostomies for benign affections.

(2) It occurs indifferently in cases of hyperacidity and normal and subnormal acidity.

(3) It may follow either anterior or posterior gastro-enterostomy. The anterior operation gives greater protection against perforative peritonitis.

(4) Peptic ulcer often runs its course without symptoms, at other times there are nightly pains.

(5) In half of the recoveries a recurrence of the ulcer has been observed, hence an unknown individual disposition may be assumed.

VIII. Intestinal Poisons in Ileus. By Dr. P. Clairmont (Vienna). In collaboration with Dr. Ranzi, the author studied the nature of poisoning by intestinal contents in ileus. His results were as follows: The intestinal contents above the stenoses, after

being rendered free from bacteria by infiltration, always proved poisonous, whether administered intravenously or hypodermically, Bouillon cultures of small quantities of the intestinal contents after four to five days gave toxins equally poisonous. Thus the poison is the result of bacterial growth. It can also withstand heat. The toxic action can be paralyzed by mixing the material with the brains of normal rabbits or guinea-pigs. The filtered intestinal contents in some instances showed intense hæmolytic power when administered to dogs or horses. It was impossible to establish either active or passive immunity to the poisons, which seems to show that an extension of serum therapy to the treatment of ileus is impossible.—*Proceedings of the German Surgical Congress of 1903.*

IX. Subcutaneous Rupture of the Gall-duct. By Dr. Florian Hahn (Nürnberg). The author reported the case of a four-year-old boy who was run over. Six weeks later there was found extreme emaciation, enormous abdominal distention, encapsulated exudation, marked dyspnœa. The scleræ were white. Pulse, 150. No fever.

Laparotomy showed fluid in belly is bile, chronic peritonitis with formation of firm adhesions and membranes several millimetres thick. Tamponade. Inquiry elicited that there had been icterus beginning three days post-trauma, at its height in eight days, and lasted five weeks. The diagnosis of injury to the ductus choledochus was now made.

A second laparotomy was done eleven days after the first operation, but the point of rupture was not found. Bile escaped through a horseshoe opening to the right of the spine, on the under surface of the third part of the duodenum, *i.e.*, it must have made its way behind the duodenum and pancreas. The unnatural biliary opening was firmly tamponed. Two days after there was bile in the stools, and after four weeks the stools were normal. Complete recovery.—*Proceedings of the German Surgical Congress of 1903.*

X. Resection of the Rectum through the Abdomen. By DR. SCHLOFFER (Prag). Schloffer considers that abdominal resection and suture of the rectum is not so difficult as is usually thought, even when the tumor does not reach higher than the peritoneal reflection. In such cases it is very easy to mobilize the tumor, if one places the patient in a position with the pelvis greatly elevated, and after opening the belly cuts the parietal peritoneum circularly two finger-breadths distant from the tumor, and at the same time divides the mesentery of the pelvic colon. The extraperitoneal part of the rectum is easily separated from its loose cellular bed and pulled almost into the wound in the belly wall. By cutting through the gut two finger-breadths below the tumor one always leaves at least a finger-breadth cuff of the lower rectum, which can be pulled up to the peritoneum and sutured to the upper segment of gut without difficulty. Of Schloffer's two cases, one is cured; the other died after four weeks of an acute infectious enteritis. Preliminary colostomy is advised.

KÜMMELL (Hamburg) uses laparotomy as a preliminary operation to loosen the mesorectum. After this excision is easy through a pararectal incision.

KRASKE (Freiburg) uses the combined method, as by it the removal of the lymph glands in the concavity of the sacrum is rendered easier.—*Proceedings of the German Surgical Congress of 1903.*

XI. Contribution to Splenic Surgery. By DR. JORDAN (Heidelberg). Jordan exhibited the following specimens and shortly sketched the clinical history and indications for operation in each.

(1) A four kilogramme blood cyst which was removed four years ago by splenectomy in a woman of forty-six. Complete recovery.

(2) Primary echinococcic cyst from a girl of fifteen. Splenectomy was difficult because of extensive adhesions, especially with the diaphragm. Recovery.

(3) Simple hyperplastic spleen (one kilogramme) coexisting with hydrops of gall-bladder, cholelithiasis, and enlargement of liver. Splenectomy and cholecystostomy in the same sitting. Recovery.

(4) Simple hyperplastic spleen (one and one-half kilogramme) removed from a woman of fifty-two, who was anæmic from hæmorrhage due to endometritis fungosa. Recovery. Five months later death from cerebral softening, due probably to the anæmia.

(5) A primary lymphosarcoma removed seven years ago from a boy of sixteen. Recovery. Death after one and one-fourth years from metastasis.

(6) Simple hyperplastic spleen (four kilogrammes) removed from a man of fifty-two. Death, twenty hours after operation, from heart failure and parenchymatous hæmorrhage in the tumor bed.

(7) A spleen, showing two deep fissures, removed three years ago from an extremely anæmic officer who had sustained a kick from a horse. Recovery.—*Proceedings of German Surgical Congress of 1903.*

XII. The Pathogenesis and Therapy of Acute Pancreatic Hæmorrhage (Hæmorrhagic Pancreatitis). By Dr. Bunge (Königsberg). The results of operative treatment of acute pancreatic diseases have been so bad that the majority of surgeons advise procrastination, *i.e.*, endeavor to keep the patient alive until the disease reaches the chronic stage, when operation may be performed with less danger.

Recently, Hahn has been operating early (laparotomy and peritoneal drainage). The author reports recovery after early operation in a case of pancreatic hæmorrhage in a very fat woman of fifty-one years. The patient became acutely affected with what appeared to be a highly seated intestinal obstruction. Vomiting at first of bile, later of intestinal contents; frequent colicky pains

radiating from the epigastrium. Pulse rapid, small. Laparotomy; omentum and mesentery of all the intestines exhibited fat necrosis; free effusion of blood in peritoneum. As a result of destruction of fatty tissue there was a hole the size of a fist in the gastrocolic omentum. In the depth of the *bursa omentalis* there lay the pancreas, enlarged in every dimension and containing hæmorrhagic infarcts. Bloody infarcts in mesocolon. Tamponade of the bursa omentalis from in front, of the mesocolon underneath. Recovery after persistent suppuration. For eight days there was glycosuria.

The author advises immediate operation when acute hæmorrhagic pancreatitis is diagnosed with certainty or probability. In rare cases, the operation will consist merely in laparotomy and peritoneal drainage.

Since necrosis and suppuration of the pancreas may be generally expected, it is commendable to shut off the pancreas from the peritoneal cavity by gauze packs introduced through the gastrocolic omentum and behind the stomach and mesocolon.

The author has found by injecting air, paraffin, and especially oil into the principal arteries of the pancreas, that he could regularly produce hæmorrhagic pancreatitis with extensive fat necrosis in the abdomen. He thinks that embolism plays a great rôle in causing the disease.—*Proceedings of the German Surgical Congress of 1903.*

JOHN F. BINNIE (Kansas City).

XIII. Pneumococcus Peritonitis; a Typical Symptom Complex. By DR. MAX VON BRUNN (Tübingen). Pneumococcus peritonitis is a comparatively rare disease even in cases of pleuropneumonia, when the possibility of infection is near at hand. It is more frequently secondary to pneumonia than primary. It is much more frequent in children than in adults. Of the seventy-four reported cases, fifty-seven were children under fifteen years, and with few exceptions female. After a premonitory period, in

which in most of the cases symptoms of bronchitis, bronchopneumonia, croupous pneumonia, or pleuritis were present, sometimes without any of these, suddenly the symptoms of peritonitis, general or local, are ushered in. High fever and diffuse abdominal pain, either colicky, continuous, or intermittent in character. Vomiting and diarrhœa. Occasionally constipation. After a few days these severe symptoms abate. The fever drops, the vomiting ceases, and the pain lessens. The general condition of the patient is better. The symptoms may become localized. This chronic stage may last for weeks, with few symptoms of peritonitis. As a rule, distinct localizing symptoms appear. The intestines become distended with gas, and after a short time a collection of fluid, either circumscribed or free, may be made out. It often becomes sacculated between the navel and the symphysis or in the region of the umbilicus. The nature of the fluid remains often uncertain, for, despite the presence of pus, the temperature may drop and remain normal for some time. A septic temperature is the exception. The abdomen is often not tender to the touch. The general condition may remain good for some time, but there is gradual loss of flesh and strength. The exudate increases in quantity. Often the pus finds its own exit, frequently through the umbilicus. This tendency to find exit through the umbilicus is one of the most characteristic symptoms. With the escape of the pus, the symptoms often abate rapidly.

Of the seventeen reported cases in adults, only five followed the typical course seen in children. The other cases presented the usual symptoms of a septic peritonitis.

It is necessary to consider the possibility of pneumococcus peritonitis when, after symptoms of an acute peritonitis, the symptoms abate and an exudate remains in the abdominal cavity, which tends to become encapsulated in the umbilical region or in the hypogastrium.

Conclusions.—1. Pneumococcus peritonitis is a comparatively rare disease, more frequent in children than in adults, in girls more frequently than in boys.

2. It occurs secondary to diseases of the lungs or middle ear, or may be primary.

3. The exudate is very rich in fibrin, which very quickly tends to mat together the intestines and become sacculated. In the most advanced cases the entire mass of intestines becomes matted into a lump surrounded by pus.

4. There is a typical symptom complex. In typical cases, especially in children, it begins as an acute peritonitis, which is followed by a chronic stage, with comparatively few symptoms referable to the peritoneum.

5. The probable diagnosis may be made, without bacteriological examination, from the typical course of the disease and the characteristic appearance of the pus (greenish-yellow in color, odorless, rich in fibrin). Bacteriological examination will determine it definitely.

6. Prognosis is good. Spontaneous recovery is possible, but rare. Recovery following operation is the rule.

7. Treatment consists of evacuating the pus and drainage.—*Beiträge zur klinischen Chirurgie,* Band xxxix, Heft 1.

XIV. Surgery of Carcinoma of the Stomach at the Clinic of Professor Krönlein, in the Years 1881–1902. By Dr. Schönholzer (Zurich). The following questions are considered:

(1) Is an operation advisable in carcinoma of the stomach?

(2) Is exploratory operation justifiable as a means of early diagnosis in suspected carcinoma of the stomach?

(3) Shall gastrectomy in carcinoma of the stomach be considered as simply a palliative operation, or is the disease actually curable by this operation?

(4) Is it possible by means of a gastro-enterostomy to lengthen the lives of the patients, or at least make them more comfortable?

Two hundred and sixty-four cases are reported. These cases are divided into two groups: (A) Inoperable cases, *i.e.*, cases not

operated upon (sixty-seven cases), and cases subjected to exploratory laparotomy (seventy-three cases). (B) Operable cases, embracing fifty cases of gastrectomy and seventy-four cases of gastro-enterostomy.

Of the cases not operated upon, fourteen refused operation. The remaining fifty-three were refused operation on account of the advanced stage of the disease. Among these latter patients the average duration of life after the examination was seventy-three days. Of the fourteen who refused operation, the average duration of life was 200 days.

In seventy-three cases exploratory operation alone was done. Radical operation was impossible on account of large, deeply adherent tumors, with numerous metastases. Gastro-enterostomy was not performed: (1) Because no symptoms of stenosis were present; (2) because, even where stenosis was present, the disease was so far advanced that interference was useless. Of these cases, seven died within the first eleven days after the operation, three of pneumonia, four of marasmus, and one of embolus of the lung. A mortality of 9.5 per cent. The two classes taken together average ninety days before death in the inoperable cases.

The indications for gastro-enterostomy, as formulated by Professor Krönlein, are as follows: (1) In the cases of pyloric stenosis where extirpation is impossible, and in which the symptoms of stenosis are present; (2) in those cases in which, without marked pyloric obstruction, the symptoms of stagnation of the stomach contents stand out most clearly in the symptom complex.

In the seventy-four cases in which gastro-enterostomy was done, the mortality was 24.3 per cent. The causes of death were: Collapse, 7; circulus vitiosus, 6; pneumonia, 2; peritonitis perforative, 3.

In the technique of the gastro-enterostomy, the gastro-enterostomia retrocolia post. of Professor Krönlein was always given the preference, except where adhesions or infiltration of the posterior stomach wall made this impossible, when the method of

Wölfler was followed. The anastomosis is made with the jejunum about twenty to thirty centimetres from the plica duodenojejunalis. The incision in the stomach and intestine is two to three centimetres long. To prevent angulation of the gut, the intestine is stitched to some extent to the stomach wall. In the anastomosis, two running silk sutures are used,—the first including the entire thickness of the stomach and intestinal walls, and the second the serosa only.

Generally, a few hours after the operation, the patient receives very small amounts of tea with cognac by mouth; on the first day following, milk with tea in small but frequent doses; on second day, gruel, broth, with eggs. Very early semi-solid food. Nutrient enemata containing 125 grammes of red wine, 125 grammes of milk, yolk of two eggs, and a small amount of salt are given. To allay thirst, subcutaneous infusions of salt solution are given. When vomiting is excessive, the stomach is carefully washed out. The average duration of life after the operation (fifty-one cases) was 192 days.

In answer to the question, "Does the gastro-enterostomy lengthen the life of the patient, or at least make them more comfortable?" it is concluded that through this medium the period of life has been lengthened 100 days (fifty-one cases). The average in the cases not operated upon being death after ninety days, in the operated cases, death after 192 days.

Again, the cases are divided into three classes:

(1) Cases with very fine result. Of these there were seventeen cases, living on the average 470 days after the operation; three operated after the method of Wölfler, fourteen after the method of v. Hacker.

(2) Cases with good result. Seventeen cases living on the average 141 days; four after Wölfler's method, thirteen after v. Hacker's method.

(3) Cases with little or no improvement. Twenty-one cases, average length of life, sixty-four days after operation, six after

Wölfler's method, fourteen after v. Hacker's method, and one after the Billroth-Brenner method. Eighteen cases died from the operation; one case could not be followed.

Almost all of the cases operated upon were patients suffering from stenosis of the pylorus, with the symptoms of stagnation and retention of food, and it is surmised would have lived on the average about three months.

In the third set of cases, in general, the anastomosis was successful, the appetite improved somewhat, but in spite of this the pain did not diminish, and the strength rapidly failed. All of these cases were far advanced at time of operation.

In the first set of cases the greater part of the stomach wall was intact. The entire picture was less malignant, and the symptoms pointed more towards the stenosis and not the carcinoma as being the cause of the symptoms. From these cases, the conclusion is drawn, that the ideal case for a gastro-enterostomy is a carcinoma of the pylorus, in which resection of the same is contraindicated on account of adhesions or metastases. Even if the growth, as is generally the case, has extended onto the lesser curvature, the point of chief importance being that the greater part of the stomach wall is intact, which would indicate that the stomach retains still its vital energy and ability to functionate. In the cases, however, in which the infiltration has spread out over the anterior and posterior walls of the stomach, the operation is contraindicated. v. Mikulicz says, "The advantage of the gastro-enterostomy seems small in comparison with its dangers. It is only indicated in pyloric stenosis with stagnation." Brunner says, "Too many gastro-enterostomies are done. It is contraindicated in cases where a rapid invasion of the anastomosis with carcinomatous disease is evident."

In the first set of cases the after effects were very satisfactory. The vomiting and pain ceased, the appetite returned, and the general condition of the cases was remarkably improved. It is concluded, from these and the second set of cases, that the

suffering in carcinoma of the stomach is due mostly to the symptoms arising from the stenosis and the stagnation of the food. The cases of gastrectomy are not reported in this number.—*Beiträge zur klinischen Chirurgie,* Band xxxix, Heft 1.

XV. Anatomy and Pathology of the Gall-ducts and Pancreas. By PROFESSOR DR. O. V. BÜNGNER (Hanau). The chief questions considered are:

(1) The course of the ductus choledochus, and its relation to the pancreas.

(2) Does the duct of Wirsung join with the ductus choledochus to form a single duct, and, if so, what is the length of this common duct, or do the two empty through separate openings into the duodenum? What is the relation of these openings to each other?

(3) Does the duct of Wirsung run, in the majority of cases, as a simple duct, or does it divide and give off a collateral duct—the ductus Santorini? How often does the latter happen, and at what point does the collateral duct enter the intestine?

The writer has made dissections of fifty-eight subjects, of varying ages, to answer these questions.

The choledochus coursed fifty-five times through the substance of the pancreas, and only three times over the head of the organ. In the fifty-five cases it passed through the upper right hand portion of the head of the pancreas for an average distance of two centimetres. It was covered by 0.5 centimetre of pancreatic tissue, and was very firmly embedded in the tissue, so that it could not be dissected out. The average length of the choledochus was 7.8 centimetres (maximum, 11.5; minimum, 4.0 centimetres).

The duct of Wirsung joined the choledochus in the substance of the pancreas only in one case. In all the other cases the ducts open separately into the diverticulum Vateri of the papilla. In twenty-one cases the Wirsungianus opened behind, above, and

to the side of the choleduchus; seventeen times behind, above, and medial to the choledochus; four times behind, below, and to the side of the choledochus.

The Wirsungianus, as a rule, does not divide. Only occasionally (about 10 per cent. of the cases) it gives off a branch which opens separately into the duodenum.

This relation of the choledochus to the head of the pancreas demonstrates: (*a*) The impossibility of complete exposure of the choledochus after it enters the substance of the pancreas; (*b*) All affections of the pancreas which lead to an atrophy or pathological enlargement of the head of the pancreas must bring about a constriction not only of the Wirsungianus, but also of the choledochus. Such a condition would give rise to the symptoms both of retention of the pancreatic secretions (fatty stools, mellituria) and of retention of the bile (clay stools, icterus, etc.).

The fact that the Wirsungianus and choledochus empty separately into the diverticulum Vateri proves that the stoppage of the one duct, even at its distal end, does not necessarily bring about a like condition in the other, and pathological processes in the one may exist entirely independent of the other. But when disease or obstruction of the diverticulum occurs, it affects both equally. —*Beiträge zur klinischen Chirurgie,* Band xxxix, Heft 1.

PAUL MONROE PILCHER (New York).

GENITO-URINARY ORGANS.

I. Beginning Prostatic Hypertrophy. By DR. A. ROTHSCHILD (Berlin). Rothschild made histological examination of thirty prostates belonging to the third, fourth, and the beginning of the fifth decades of life, *i.e.*, to the time of life when clinical symptoms of hypertrophy arise. He carefully excluded cases of death from diseases which might invalidate the correctness of his observations. In 90 per cent. of the cases there was homogeneous, chronic inflammatory changes of the prostatic glands, viz., glandular catarrh with proliferation and desquamation of the epithe-

lium or pus mixed with the secretion, and an intercellular collection of round cells in foci situated under the epithelium or between the glands. In places there was connective-tissue induration. Finger found the same histological condition in only seven out of 120 cadavers, where the disease followed directly on chronic gonorrhœal urethritis. Ciechanowski found the identical condition in a number of true prostatic hypertrophies in old people. He considers the hypertrophy chiefly due to a passive widening of the glands, the result of the formation of connective tissue (subepithelial or periglandular) causing partial or complete closure of the lumen of the gland outlet, by means of which the gland substance becomes ultimately destroyed. He concludes that neither a glandular, neoplastic growth, nor a primary increase of the muscle is usually responsible for the prostatic enlargement. Rothschild agrees with Ciechanowski and Finger that gonorrhœa is the most common cause of prostatic hypertrophy.—*Proceedings of the German Surgical Congress of 1903.*

JOHN F. BINNIE (Kansas City).

REVIEWS OF BOOKS.

A Text-Book of Surgery. By George Emerson Brewer, A.M., M.D. Philadelphia and New York: Lea Brothers & Co., 1903.

This book, a one-volumed text-book of surgery, is from the pen of a logical thinker and experienced teacher. It presents the subject within the space of 700 pages of easily readable type, and is dedicated to the author's teacher and chief, Dr. Robert Weir.

The chief aim of the author is to furnish a comprehensive yet abridged text-book of surgery suitable for the use of students and practitioners, which shall still present clearly the accepted modern views of surgical pathology, diagnosis, and treatment. In pursuance of this plan, the author has adopted an arrangement of subjects varying but slightly in detail from that generally observed.

The first section, devoted to surgical pathology, is clearly and interestingly treated, but brevity has necessitated the omission of much detail, especially in the microscopical descriptions.

Injuries of the heart, pericardium, and blood-vessels are well presented; considerable space being devoted to aneurism. Shock and allied conditions are described in an up-to-date manner, embodying the later accepted views as expressed in Crile's work. Abdominal surgery is admirably presented, especial care being expended on intestinal conditions, technique, and drainage. The section on genito-urinary surgery is one of the best in the volume. It is comprehensive: bladder, urethral, and renal affections receive particular attention. The surgery of the breast and hernia is clear and sufficiently full. The same may be said of nerve, brain,

and orthopædic conditions. Under dislocations and fractures great stress is placed on methods of reduction and subsequent treatment. The diseases of the rectum, bone, etc., fill less important chapters.

The symptomatology and diagnosis throughout are clear and concise, the latter usually including, in brief, the differential points between simulating conditions. There are no recapitulations in the form of comparative diagnostic tables which are so often helpful to the student.

Treatment, palliative and operative, embodies the best selections of recognized procedures from home and foreign surgeons; good judgment has been exhibited in the choice of operative methods.

The illustrations, of moderate number, consist of seven excellent full-paged plates in color and monochrome, five of which are original; and of numerous cuts and engravings, most of which are copies. The plates picture instructive cases of neglected carcinoma of the breast, endothelioma of submaxillary gland, arteriovenous aneurism, and sarcoma of the breast.

History and theory are almost entirely lacking. Rare and obscure conditions—those interesting only to the surgeon-specialist—receive but bare mention; yet these defects are not to be too severely criticised in a work of this character.

The volume is remarkable for its comprehensiveness and for the even fulness given to its subjects according to their relative importance, thereby emphasizing subjects of the greatest practical significance. The author keenly appreciates the need of the student,—the groundwork of surgery clearly condensed,—and to this end presents the subject-matter in a plain, pithy, and perceivable style.

As a whole, it is thoroughly practical and up-to-date: it supplies a need, fulfils its claims, and is well adapted to its purpose.

WILLIAM R. DANCY.

AN AMERICAN TEXT-BOOK OF SURGERY.. By PHINEAS S. CONNER, M.D., FREDERICK S. DENNIS, M.D., WILLIAM W. KEEN, M.D., CHARLES B. NANCREDE, M.D., ROSWELL PARK, M.D., LEWIS S. PILCHER, M.D., NICHOLAS SENN, M.D., FRANCIS J. SHEPHERD, M.D., LEWIS A. STIMSON, M.D., J. COLLINS WARREN, M.D., and J. WILLIAM WHITE, M.D. Edited by WILLIAM W. KEEN, M.D., LL.D., F.R.C.S., and J. WILLIAM WHITE, M.D., Ph.D. Fourth Edition, thoroughly revised and enlarged. One vol., large 8vo, pp. 1363. Philadelphia: W. B. Saunders & Co., 1903.

It is four years since the publication of the third edition of the "American Text-Book of Surgery," years which have witnessed marked advance in many fields of surgical endeavor. We, therefore, examine with interest a fourth edition of this work, which has been adopted as a text-book in "over one hundred medical colleges, and is in the hands of nearly forty thousand practitioners."

In the present edition there is evidence of more extensive revision than in those preceding it. Certain additions have been made. We note, first, a number of skiagraphs. With the exception of a few, illustrative of bullet wounds, a large proportion of the remainder is found in the chapters on fractures and dislocations. Yet these chapters contain but eleven skiagraphs, a number inadequate to the importance of this recent advance in diagnosing and treating these injuries. In fact, it seems to the writer that too small a proportion of the book is devoted to the subject of fractures. Detailed information, with more exact indications and directions concerning the best methods of treatment and prognosis, and more profuse and valuable illustrations in this common class of surgical cases, is of more benefit to the student and general practitioner than the details of major surgical technique. We think that more than sixty pages could wisely be devoted to fractures.

Six entirely new chapters have been added, treating of the

Examination of the Blood, of Immunity, of Tropical Surgery, of Military Surgery, of Naval Surgery, and of the Pancreas.

The excellent chapter on Syphilis has been improved by several good illustrations and slight additions to the text.

To the chapter on Tumors have been added several much needed paragraphs on the treatment of inoperable malignant disease. In this chapter appear illustrations, both new and those repeated from former editions, that exhibit extreme types of tumor growth. We think this may lead the student astray. He is so impressed with the appearance of the disease in its terminal state that he fails to recognize the early and operable stage of the same affection. A more concise definition of tumor is desirable.

We note with much pleasure that the chapter on the Surgery of the Osseous System has been rewritten. Now, for the first time, has Acute Osteomyelitis received the attention its frequency and fatality demand, and the other types of bone inflammation are clearly defined and described. The improvement in this chapter deserves especial commendation.

The chapter on Joint Diseases is as good a one as can be found in any general surgery. In that portion treating of Tubercular Joints the author lays much stress on injection methods, and considers immobilization with plaster of Paris as being the best treatment for the disease in the early stages. The magnificent results to be obtained in children by the intelligent use of the orthopædic principles—fixation, protection, and extension—do not receive the attention they deserve. The essential differences in the prognosis and treatment between these cases in children and adults are not mentioned, and nowhere in the work do we find adequate instruction concerning orthopædic treatment of joint disease.

The reports of special clinics, published and republished, are so convincing that it would seem impossible that they have had so little effect on general surgical literature and practice.

Under the subject of Ankylosis there is no warning concern-

ing the fact that the treatment advised is not applicable to tubercular joints, a mistake often made by the inexperienced.

Under Dislocations are found good descriptions and illustrations of Stimson's valuable posture method as applied to the shoulder and hip.

The few and fragmentary remarks on Diseases of the Skin, we think, might well be omitted from a general surgery except as certain portions are considered under the subject of inflammation. Just as the chapters on the eye and ear have properly been eliminated from recent editions of this work, so it would seem wise to curtail the tendency to wander into general medicine and special branches which still remain in many sections to mar the symmetry of this excellent surgical treatise. For example, the pages devoted to the internal treatment of the nose, throat, and larynx give but a superficial, and therefore dangerous knowledge of methods better described elsewhere.

The large portion of the work devoted to regional surgery contains many admirable additions. The essential features of recent publications on intestinal surgery, including hernia and the pancreas, have been made available to the student.

The rule is still given that all cases of general peritonitis must be drained. It is possible that a succeeding edition will not state this so emphatically.

The section on Genito-Urinary Surgery, while safe and conservative, does not represent the present opinion of the profession in New York in its views concerning castration *versus* prostatectomy for enlarged prostate; nor does it mention the present popular method of irrigation for urethritis. While that portion devoted to the kidney and ureter has been improved by new illustrations, skiagraphs, and text in an admirable manner, the rest of the section is but little changed and would bear further revision.

In the chapter on Operative Surgery, the subject of the aseptic technique is well handled and up to date.

It is seldom that we have so complete a revision of a book

when the previous edition is still so recent and so popular, and for this the profession is indebted to the authors and publishers. A comparison with the first edition, which is still found in many offices as a book of constant reference, shows many advances in American surgery.

WALTER C. WOOD.

TUMORS INNOCENT AND MALIGNANT: Their Clinical Characters and Appropriate Treatment. By J. BLAND-SUTTON. Chicago: W. T. Keener & Co., 1903.

This is the third edition of the author's treatise on Tumors. No great changes have been made, excepting in the chapters on deciduoma, which is described with the sarcomata, cancer, and sarcoma of the kidney, myelomata, and uterine fibroids. The section of echinococcus colonies has been restored.

The author divides tumors into four groups: 1. Connective-tissue tumors. 2. Epithelial tumors. 3. Dermoids. 4. Cysts.

He eliminates all those conditions, often classed with tumors, which have been demonstrated to depend on micro-organisms.

Each group is subdivided into genera and the genera into species.

The most instructive and interesting chapters are those on uterine fibroids and myelomata. The myelomata have been separated from the sarcomata, being distinct histologically and clinically; this distinction being of importance to the surgeon from the stand-point of treatment.

The chapters on uterine fibroids are most complete. There is, however, no mention of adenomyoma, which, according to his classification, would fall into this group. Aside from the pathological considerations, the author discusses the modes in which fibroids imperil life, relation to menstruation, pregnancy, and the menopause.

The sections on dermoids and cysts are quite exhaustive. Under the head of cysts are described hydronephrosis, congenital

cystic kidney, tubule cysts, hydrocele, pseudo cysts, neural cysts, and echinococcus colonies.

The work is essentially a book for the clinician. The author does not go minutely into the microscopic appearances of tumors, but describes briefly their histological structure. The book is well illustrated.

PAUL MONROE PILCHER.

THE DIAGNOSIS OF DISEASES OF WOMEN: A Treatise for Students and Practitioners. By PALMER FINDLEY, B.S., M.D. Philadelphia: Lea Brothers & Co., 1903.

Dr. Findley, as he states in his preface, endeavors to present a work on Diagnosis of Diseases of Women that will be useful to the student and practitioner alike and at the same time represent the most advanced thought upon the subject. One, then, naturally expects a great deal that is elementary in such a work, and is not disappointed. This fact, in the eyes of the surgeon, detracts from the worth of the book. To illustrate this we turn to Prolapsus Uteri in Part II, Special Diagnosis. The subject is introduced by a discussion of the etiological factors in producing a prolapse. Nomenclature is next considered, the above occupying one page of the text. Then the position of the patient for examination. Under the head of Anatomical Diagnosis, Inspection of the Vulva, Displacement of the Vagina, and Displacement of the Uterus are the chief sub-divisions. The inspection of the vulva is disposed of in a few lines. An entire page is given to the anatomical and pathological changes accompanying the downward displacement of the vagina. Four lines are given to the diagnosis of the same. Similarly, displacement of the uterus is considered, occupying two and a half pages, discussing the mode of formation and variation in the existing lesion rather than emphasizing the diagnostic points. Next the clinical diagnosis is taken up. One page is given to this. Then the question is asked, "Can the displacement of the vagina and uterus be corrected?" A question

which is certainly pertinent. The clinical symptoms are next dealt with, and their etiology explained rather than their bearing upon the diagnosis. The differential diagnosis occupies but eighteen lines, and is not sufficiently exhaustive to warrant the name. The chapter is well illustrated by eight cuts.

The reviewer believes that too much space has been devoted to etiological, anatomical, and pathological considerations, and too little attention paid to the direct and differential diagnosis, which are what the reader expects in such a treatise. Complications and sequelæ are not clearly enough brought out.

Cystoscopy, as an aid to diagnosis in diseases of the urinary system, is treated at some length. The author favors the Kelly-Pawlik method, and passes over rather quickly the other methods of cystoscopy. The old form of the Nitze cystoscope is shown, but no mention is made of the improved Nitze cystoscope, and also the instruments of Brunner, F. Tilden Brown, and others, which are used extensively in the East.

The importance of blood examinations in Toxæmia and Pyosepticæmic conditions seems to have been entirely overlooked.

Aside from the above criticisms, the book has many valuable points. The illustrations throughout are excellent. The chapter on the diagnosis of ectopic pregnancy is especially valuable, as it gives a clear insight into the etiology, pathology, symptoms, and diagnosis of this condition.

The book is well fitted to the needs of student and practitioner, and is to be depended upon as containing the most modern views on the diagnosis of diseases of women.

PAUL MONROE PILCHER.

ADENOMYOME DES UTERUS. Von THOMAS S. CULLEN. Baltimore: Verlag von August Hirschwald, Berlin, 1903.

The present volume of ninety-one pages is the section presented by Dr. Cullen to the Festschrift written in honor of Professor Johannes Orth to celebrate the twenty-fifth year of his professorship.

Dr. Cullen discusses at length adenomyoma of the uterus. It forms a distinct pathological entity, which may be easily diagnosticated by macro- and microscopic examination. It belongs to the non-malignant type of tumors, and when removed does not recur, but adenocarcinoma may be engrafted upon it, or the two exist independently in the same uterus.

Histologically, the myomatous character of the growth differs from that of the ordinary myoma of the uterus in that the tissue is composed of bundles of thickened fibres which spread out diffusely through the tissue, and in the meshes of this growth appear the glandular elements simulating exactly the uterine glands. In some of his reported cases he demonstrates that the mucosa of the uterus is continued into the myomatous tissue, and exactly reproduces the conditions found in the uterine cavity; the surface of the mucosa being entirely regular and intact, and the glandular structures unchanged. In the subperitoneal type the cysts resemble the cavity of the uterus.

The author presents three types:

(1) Adenomyoma with little change in the normal shape of the uterus.

(2) Subperitoneal or intraligamentary adenomyoma.

(3) Submucous adenomyoma.

Histologically, these three types are alike, except that in two and three the glandular structure does not communicate with the uterine cavity, and therefore tends to form cysts, which grow rapidly.

The author discusses further the etiology, diagnosis, prognosis, and treatment of adenomyoma, and the relation of adenocarcinoma to the same. Cases of adenomyoma of the horns of the uterus and of the round ligament are also reported. All of the cases are well illustrated. The entire subject has been carefully considered, and is a valuable addition to our knowledge of the pathology of the uterus.

PAUL MONROE PILCHER.

A Text-Book of Clinical Anatomy. By Daniel N. Eisendrath, A.B., M.D., Clinical Professor of Anatomy in the Medical Department of the University of Illinois (College of Physicians and Surgeons); Attending Surgeon to the Cook County Hospital, Chicago, etc. Octavo, pp. 515, illustrated. Philadelphia, New York, London: W. B. Saunders & Co., 1903.

Professor Eisendrath has succeeded admirably in presenting a work on practical anatomy which is designed to bridge over the chasm between the descriptive and comparative anatomy usually taught medical students and the anatomy that is useful in every-day medical and surgical practice. The book is written by a teacher of anatomy who has the problems of surgery ever before him. He takes it for granted that the reader is familiar with the details of descriptive anatomy, and has drawn largely from his notes used in instructing third-year medical students who have completed two courses in anatomy.

One of the strong points of the book is the surface tracings of viscera, which have been marked out on an artist's model and then photographed. Another valuable feature is a description of the various fasciæ which are of practical surgical importance in determining the direction in which pus will burrow.

Localization of centres in the brain and cord; distribution of nerves; location of important arteries and nerves, and practical relations of the various viscera are all treated thoroughly and accurately. Not the least important part of the work is a discussion of the deformities occurring in fractures and dislocations, with plates made from X-ray photographs showing the muscles and fasciæ producing the deformities.

As a book of reference, the surgeon will usually find what he is looking for without the padding of the works upon descriptive anatomy, and the teacher of anatomy who aims to bring out the practical side of his subject will look in vain for a greater abundance of well selected material. The illustrations are numer-

ous,—153 in all,—and are practically all new and original. They are beautifully executed from artists' models, and are pleasing to the eye as well as illustrative of the subject matter. The models, however, are not of the variety used for making illustrations for some of the recent text-books, which escape the police only by the fact that they belong to medical literature. These models are all boys and wear fig-leaves.

GEORGE R. WHITE.

A TEXT-BOOK OF THE SCIENCE AND ART OF OBSTETRICS. By HENRY J. GARRIGUES, A.M., M.D., Consulting Surgeon to the New York Maternity Hospital, etc. Octavo, pp. 844, 504 illustrations. Philadelphia and London: J. B. Lippincott Company, 1902.

Over thirty years have elapsed since the University of Copenhagen conferred the degree of Doctor of Medicine upon the author of this book, and over thirty years, too, have passed away since he became a resident of the city of New York and engaged in the active practice of his profession. Early in his career he became interested in the subject of obstetrics, and for many years was widely known to those graduate students who came to this city for practical work as the Professor of Obstetrics in the Post-Graduate Medical School. He has long been actively connected with the Maternity Hospital, forming a part of the old "Charity" Hospital on Blackwell's Island, and in the course of years has had a wide experience in this particular branch of medical science.

This practical knowledge he has now incorporated into a book along similar lines of thought to those of the work on "Diseases of Women" by the same author.

The arrangement followed is peculiar, and in many ways to be commended. The first on "Normal Division" includes four parts,—the foundation, normal pregnancy, normal labor, and normal puerpery,—each divided into a series of chapters, some of them only a few lines long. So minute a subdivision is employed

that the table of contents is really more satisfactory as a means of reference than the rather meagre index which follows. The remainder of the volume is similarly classified under the general heading "Abnormal Division,"—abnormal pregnancy, labor and puerpery, obstetric operations, and the diseases of the new-born.

So far as the number of illustrations is concerned the book is well supplied, but unusual contrasts exist in the merit of those introduced. Many cuts are old acquaintances taken from other books, quite a number are new and some are of unusual interest. Those of the photogravure type are as a class well reproduced, but the few colored plates are badly executed, and some that appear to have been taken from class-room wash-drawings are but little better. The list of illustrations, so often omitted from medical works, is an excellent one, and is subdivided into classes by subjects, so that it is possible for a reader to find a given group readily.

A chapter is devoted to the construction and management of lying-in institutions. Practically, the only one mentioned is the second class hospital on Blackwell's Island, built under Dr. Garrigues's direction, and the architectural plans of which are reproduced. The Sloane Maternity and the New York Lying-In, the acme of hospital excellence of the world, are not even mentioned.

Similarly, many other subjects are much restricted in their view, from an evident desire on the part of the writer to present what he considers the best mode of procedure rather than to present a number of different methods to accomplish the same result. In treating of symphyseotomy, for example, most of the instruments shown are those devised or modified by Garrigues, while other and better ones are omitted. In the historical sketch which preceded the article in question there are several references to the work done by the author, but no reference to the work of Jewett, the first to perform the operation in America after its modern revival.

Personal experiences and personal opinions are always of

value when coming from one who is felt to have the right to tell of them, and to the large number of his former students scattered over the country the volume of Dr. Garrigues will doubtless prove of unusual interest.

HENRY P. DE FOREST.

MANUAL OF PRACTICAL ANATOMY. By D. J. CUNNINGHAM, M.D., D.Sc., LL.D., D.C.L., F.R.S., Professor of Anatomy in University of Edinburgh. Third Edition, crown 8vo. Philadelphia: J. B. Lippincott Company, 1903.

This work consists of two handy volumes of 580 pages each, intended especially for the aid of the student in the dissecting-room.

Volume I treats of the structures found in the upper and lower limbs and abdomen. Preceding each division of the text is a very full description of the dissection of the part, as the dissector comes down upon it.

The back and its superficial structures are first considered, then the pectoral region and axillary space and shoulder, describing the muscles uncovered and the arteries and nerves seen in relation to them; however, the author does not state their final distribution. The nerve supply to a muscle might better be impressed on the student's mind, if, in conjunction with the name of the terminal trunk, the spinal nerves from which it arises should also be given.

The structures in the axillary space are very well described, and the accompanying illustrative diagrams are especially good. Here it may be said that while the illustrations are rather diagrammatic, they portray the condition accurately, and are very well executed. Their profuseness and evident originality in a large majority of cases form a very noticeable and commendable feature. In the arm, forearm, and wrist several cross sections are introduced. Accompanying each set of muscles, which are described fully, is appended a print of the bones of the part, with

colored muscular attachments. In the abdomen, the description of the visceral relations shows the effect of the rapid evolution which this department of anatomy has lately undergone. Each viscus is described as if in physiological activity, the illustrations showing the various organs hardened by formalin *in situ*. The peritoneum is considered clearly, concisely, and with an absence of that confusion which so often attends it, being accompanied by very clear illustrations. The consideration of the pelvis is quite exhaustive and easily appreciated.

Volume II takes up the thorax, head, and neck, together with the brain, auditory apparatus, and eyeball.

The description of the structures at the root of the neck is especially clear, and is accompanied by valuable illustrations. The thoracic viscera are well described in physiological distention. The description of the diaphragm is especially commendable. The heart is considered very thoroughly, and is accompanied by many good illustrations.

JAMES TAFT PILCHER.

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INDEX TO VOLUME XXXVIII.

A

Abdomen, Closure of wounds of the, one thousand cases, by a new method without hernia, 664; Gunshot wound of, with bullet and wad of clothing in peritoneal cavity, 447; with perforation of stomach and intestines, 450; Surgical Diseases of the, Review of Douglas on, 466.

Abdominal operations, Question of drainage after, 139; surgery, The gauze-bearing tape in, 778; wall, large defects in, Filigree for the repair of, 47.

Actinomycosis in man, Method of infection of, 292.

Allis, Oscar H., Traction apparatus for reduction of dislocation of hip, 890.

American Surgical Association, Transactions of, for 1902, Review of, 471; Text-Book of Surgery, Review of, 929; Year-Book of Medicine and Surgery for 1903, Review of, 159.

Anæsthesia, Local, 825.

Anatomical model, A well-proportioned, 120.

Anatomy, Applied Surgical, Review of Woolsey on, 470; Deaver's Surgical, Review of, 459; Heath's Practical, Review of, 461; Manual of Practical, by D. J. Cunningham, Review of, 939; Text-Book of Clinical, by Daniel N. Eisendrath, Review of, 936.

Andrews, E. Wyllys, Fractures of the spine, 310.

Aneurism, Case of fusiform, treated by Matas's method, 493; of external iliac artery, Treatment of, by digital compression, 498; of subclavian artery, Traumatic, produced by fractured clavicle, 638.

Aneurisma racemosum, An aggravated case of, 496.

Ankle, Congenital luxation of, 545.

Anuria, calculous, Diagnosis and treatment of, 503.

Appendicitis complicated by black vomit, 108; Operation for, followed by gangrene of colon and ileum, 367.

Appendix vermiformis, Intussusceptions associated with inversion of the, 708.

Arteries, Gradual surgical occlusion of large, 256; in bone, Distribution of, and their relation to foci of disease, 893.

Ascites due to liver cirrhosis treated by operation, 361.

Auricle, stab wound of right, Suture of, 905.

B

Baldwin, James Fairchild, One thousand abdominal closures by a new method, without a known hernia, 664.

Banti's disease, Splenectomy for, 671.

Bartlett, Willard, Improved filigree for the repair of large defects in the abdominal wall, 47.

Beck, Carl, An aggravated case of aneurisma racemosum, 496.

Berg, Albert Ashton, Method of retroduodenal choledochotomy, 275; Surgical treatment of cholelithiasis, 343.
Bevan, Arthur Dean, Treatment of complications of chronic gallstone disease, 456.
Bile duct, common, Exposure of postduodenal portion of, 480; Exposure of postduodenal portion of, 608; Removal of calculi from retroduodenal portion of the, 275.
Billings, Frank, Treatment of complications of chronic gallstone disease, 455.
Binnie, John Fairbairn, Myositis ossificans traumatica, 423; Exposure of postduodenal portion of common bile duct, 608.
Black vomit complicating appendicitis, 108.
Bladder, Complete extirpation of, for carcinoma, 445; exstrophy of, Modified Maydl's operation for relief of, 763; papilloma of, Accidental cure of, 890; urinary, Hernia of, 606.
Blake, Joseph A., Torsion of the omentum, 99; Treatment of stricture of the œsophagus, 105; Treatment of the peritoneum in diffuse peritonitis, 265.
Blood examinations in their relation to surgical procedures, 418; in cancer, Chemistry of, 444.
Bloodgood, Joseph C., Intestinal obstruction following operation for surgical hernia, 806.
Bolton, Percy R., Bullet wound of stomach and intestines, 450.
Bone. Distribution of arteries in, and their relation to foci of disease, 893.
Brain, Abscess of cortex of, 116.
Branchial fistulæ, König's method of treating, 759.
Breast, Cystic degeneration of, transformation into carcinoma, 336; male, Tumor of, 450; Operative possibilities in cases of advanced carcinoma of, 321.
Brewer's Text-Book of Surgery, Review of, 927.
Brinton, John H., Fractured bones in the lower animals, 889.
Bronchial lymph glands, Recurrence of hypernephroma in, 910.

C

Cabot, Arthur Tracy, Calculous anuria: Its diagnosis and treatment, 503.
Calculous anuria, Diagnosis and treatment of, 503.
Cancer, Chemical hypothesis for the causation of, 280; Hypothesis for etiology based on chemistry of the blood, 444.
Cardiolysis and its indications, 907.
Carotid artery, common, Ligature of, death from anomaly of Circle of Willis, 878.
Carpal scaphoid bone, Dislocation of the, 97.
Catheter in peritoneal cavity, 446.
Cheek, Plastic on, after excision of epithelioma, 113.
Chicago Surgical Society, Transactions of, 310, 453.
Cholecystenterostomy combined with entero-anastomosis, 763.
Cholecystitis, Operative treatment of acute infections of, 140.
Choledochotomy, retroduodenal, Proposed method for, 275.
Cholelithiasis, Surgical treatment of, 343.
Clavicle, Dislocation of the outer end of the, 403; Ununited fracture of, treated by suture, 99.
Cobb, Farrar, Operative treatment of recurrent dislocation of the ulnar nerve, 652.

COFFEY, R. C., Contribution to the surgery of pyosalpinx, 540.
Colon, Idiopathic dilatation of, 736.
CONNELL, F. GREGORY, Local anæsthesia, 825.
COOPER, C. M., Exposure of the postduodenal portion of the common bile duct, 480.
CORNER, EDRED M., Pathology and classification of intussusceptions, 690.
Cullen on Adenomyome des Uterus, Review of, 934.
Cunningham's Manual of Practical Anatomy, Review of, 939.
CURTIS, B. FARQUHAR, Thyroidectomy and sympathectomy for exophthalmic goitre, 161.
Cystocele complicating inguinal hernia, 106.

D

DANCY, WILLIAM R., Review of Brewer's Text-Book of Surgery, 927.
DANDRIDGE, NATHANIEL PENDLETON, Gangrene of colon and ileum after operation for appendicitis, 367.
DAVIS, G. G., Rupture of liver, 123; Operation for intestinal perforation in typhoid fever, 127.
DEAVER, JOHN B., Surgical treatment of exophthalmic goitre, 202; Surgical Anatomy, Review of, 459; Treatment of complications attendant upon chronic gall-stone disease, 549.
DE FOREST, HENRY P., Review of Garrigues's Text-Book of Obstetrics, 937.
Diabetes and cancer, 444.
Douglas on the Surgical Diseases of the Abdomen, Review of, 466.
Drainage after abdominal operations, Question of, 139.
Du Bois-Reymond's Treatise on Specielle Muskelphysiologie, Review of, 316.
Duodenum, Review of three hundred and three operations upon the stomach and first portion of the, 30.
Dupuytren's contracture, 765.

E

Eisendrath, Text-Book of Clinical Anatomy, Review of, 936.
ELDER, JOHN M., Further case of "hour-glass" stomach, 593.
ELLIS, ALLER G., Cystic degeneration of mamma; Transformation into carcinoma, 336.
ELSBERG, CHARLES A., Surgical features of perforation of the intestine in children, 71.
ELY, LEONARD W., Dislocation of the carpal scaphoid, 97.
Embryology, Minot's Text-Book of, Review of, 469.
Empyema of the sphenoid, 137; of thorax, Resection for, 908.
Epilepsy, Jacksonian, non-traumatic, Surgical treatment of, 898; traumatic, Case of trephining for, 783.
ERDMANN, JOHN F., Black vomit after operations on appendix, 108; Suture of femur for non-union, 300; Operative reduction of irreducible dislocation of shoulder, 449.
Ethmoidal inferior turbinate bone, Anatomy of, 233.
Exophthalmic goitre, Surgical treatment of, 161, 202.
Exstrophy of bladder, Modified Maydl's operation for relief of, 763.

F

Facial paralysis, Treatment of, by nerve transplantation, 901.
Femur, Suture of ununited fracture of, 300.
Filigree for the repair of large defects in the abdominal wall, 17, 302.

Findley on the diagnosis of diseases of women, 933.
Flat-foot, Tenoplasty for, 150.
Foreign bodies embedded in the tissues, Localization of, by X-rays, 478.
Fowler, George R., Value of Bier's method in the treatment of joint tuberculosis, 106; Black vomit in appendicitis, 109.
Fractured bones in lower animals, Cases of, 888.
Freiberg, Albert H., Congenital luxation of the ankle, 545.

G

Gall-bladder, Carcinoma of, 600; Exclusion of, after cholecystenterostomy, 764; Rupture of the, 122.
Gall-duct, Subcutaneous rupture of the, 915.
Gall-ducts and pancreas, Anatomy and pathology of, 924.
Gall-stone disease, Treatment of the complications attendant upon, 453; chronic, Treatment of complications attendant upon, 549.
Gall-stones, Kehr's statistics of seven hundred and fifty laparotomies for, 141.
Gangrene of leg, Embolic, after acute lobar pneumonia, 380.
Garrigues's Text-Book of the Science and Art of Obstetrics, Review of, 937.
Gastric and Duodenal Ulcers, Review of Moynihan on the Surgical Treatment of, 466.
Gauze-bearing tape in abdominal surgery, 778.
Genito-Urinary Organs, Review of Keyes on the Surgical Diseases of the, 153.
Gibbon, John H., Rupture of the spleen, 123; Intestinal perforation three weeks after operation for strangulated hernia, 132.
Gibson, Charles L., Endothelioma of the parotid gland, 112; Results of operations for prostatic hypertrophy, 306; Embolic gangrene of leg as sequel to acute lobar pneumonia, 380; New method of performing perineal section without a guide, 518.
Goelet, Augustin H., Method of suturing the prolapsed kidney, 769.
Goitre, exophthalmic, Thyroidectomy and sympathectomy for, 161; Surgical treatment of, 202.
Gould, Alfred H., Case of malignant œdema, 481.
Grant, W. W., Bridge for treatment of nasal fractures and deformities, 441.
Gravity pad in abdominal surgery, 778.

H

Hand and foot, Hard, traumatic œdema of dorsum of, 149.
Harris, Malcolm L., Fractures of the spine, 311.
Harte, Richard H., Three successful laparotomies for intestinal perforation in typhoid fever, 63, 127.
Hartmann's Travaux de Chirurgie Anatomo-clinique, Review of, 461.
Hawkes, Forbes, Bullet and wad of clothing removed from the peritoneal cavity, 447.
Hawley, George Waller, The surgical problem in prostatic hypertrophy, 609.
Head, Surgery of the, Review of Holmes on, 465.
Heart bound by adhesive pericarditis, Operation for relief of, 907.
Heart suture, 902, 905.
Heat, Local effects of, 895.
Hernia, inguinal, complicated by cystocele, 106; Intestinal obstruction following operation for, 806; strangulated, Operation for, fol-

lowed by intestinal obstruction after three weeks, 132; umbilical, Radical cure of, 118; umbilical, Autoplasty for, 302; of urinary bladder, 606; Ventral, closed with silver filigree, 302.
Hip dislocation, Traction apparatus for, 890.
Hirst's Text-Book of Obstetrics, Review of, 319.
Holmes on The Surgery of the Head, Review of, 465.
Hopkins, W. Barton, Fracture in the lower animals, 888.
Horsley, J. Shelton, Contribution to the study of intestinal suture, with a new method of intestinal union, 741.
Horwitz, Orville, Accidental cure of papilloma of bladder, 890.
Hotchkiss, Lucius W., Plastic on cheek, 114; Cortical brain abscess, 116; Suppurating hydatid cyst of the liver, 309; Gunshot wound of liver; Fatal hæmorrhage after eight months, 448; Penetrating shot wound of the lung, 597; Mastoid abscess, with thrombosis of lateral sinus, 599; Acute pancreatitis, 604.
"Hour-glass" stomach, Case of, 593.
Howe, Walter C., Anomalies in the Circle of Willis, 878.
Hutchinson, J. P., Intestinal perforation in typhoid fever, 128.
Hydatid cyst of liver, 307, 309.
Hypernephroma, Recurrence of, in bronchial lymph glands, 910.
Hypochondriac and epigastric regions, Exposure of, by raising osteoplastic flap of arch of ribs, 764.

I

Ileus, Intestinal poisons in, 914.
Iliac artery, external, Treatment of aneurism of, by digital compression, 498.
Ill, Edward J., Tubercular diseases of the female urinary tract, 524.
Intestinal carcinoma, Anatomical and clinical researches in, 911; Localization, 574; Obstruction, 102; Obstruction following operation for inguinal hernia, 806; Perforation after operation for strangulated hernia, 132; Perforation in typhoid fever, Successful laparotomies for, 63, 127; Perforation in typhoid fever in children, Surgical features of, 71; Poisons in ileus, 914; resection, Cases of, 135; Suture by a new method, Horsley, 741.
Intestine, Condition of, two years after extensive resection, 451; prolapsed invaginated, Operative technique of, 760.
Intussusceptions, Pathology and classification of, 690; with prolapse through anus, Operative technique of, 760.
Iodoform, Antiseptic action of, 894.
Irritants, local, Action of, 895.

J

Jaw, lower, bilateral bony ankylosis of temporal articulation, Surgical treatment of, 212; Treatment of fracture of, 630.
Johnson, Alexander B., Ununited fracture of clavicle treated by suture, 99; Carcinoma of the gall-bladder, 600.
Johnson, Robert W., Method of retaining ends of fractured bones in apposition during fixation by plaster-of-Paris dressings, 415.

K

Kammerer, Frederick, Plastics on cheek, 114; Closure of large defects in abdominal wall, 118.
Kehr's statistics of seven hundred and fifty laparotomies for gallstones, 141.

Keyes on the Surgical Diseases of the Genito-Urinary Organs, Review of, 153.
Kidney, Laceration of, 121; Extirpation of, for tuberculosis, 524; prolapsed, Method of suturing the, 769; and Ureter, Review of Morris on Surgical Diseases of the, 155.
Kidneys, Topography of, and its Relations to Kidney Surgery, Review of Zondek on, 459.
KIEFFER, CHARLES F., Congenital dislocation of both ulnæ at the wrists, 119.
KILIANI, OTTO G. I., Cystocele complicating inguinal hernia, 106; Value of Bier's method in the treatment of joint tuberculosis, 107; Black vomit in appendicitis, 109; Thrombosis of mesenteric arteries, 110; Ultimate result in case of tumor of brain, 117.
KINNAMAN, GUY C., Experimental research into temperature relationship existing in shock, 843.
Knee-joint, Removal of large loose fragment of bone from the, 124.
Krause's method of skin transplantation, 766.

L

Lane, Heath's Practical Anatomy, Review of, 461.
Lateral sinus, Thrombosis of, 599.
Lazarus-Barlow, Elements of Pathological Anatomy and Histology, Review of, 158.
LEVISON, CHARLES G., Splenectomy for Banti's disease, 671.
LILIENTHAL, HOWARD, Sarcoma of the scapula, 115; Use of silver filigree in closing large defects in abdominal wall, 118; Closure of abdominal wounds, 304; Results after prostatectomy, 307; Hydatid cyst of liver, 307; Removal of scapula for sarcoma, 308; Carcinoma of the gall-bladder, 601; Removal of scapula for sarcoma, 602; Acute pancreatitis, 603.
Liver cirrhosis, Ascites from, treated by operation, 361; Gunshot wound of; Fatal hæmorrhage after eight months, 448; Hydatid cyst of, 307, 309; Injuries of the, 147; Rupture of, 121; Tropical abscess of the, 560.
LOCKWOOD, CHARLES D., Hernia of the urinary bladder, 606.
LOTHROP, HOWARD A., Anatomy of the inferior ethmoidal turbinate bone, 233.
Lung, Penetrating shot wound of, 597.
LYDSTON, G. FRANK, Prostatic tractor for perineal prostatectomy, 359.

M

MCARTHUR, L. L., Blood examinations in their relation to surgical procedures, 418.
MCCLELLAN, GEORGE, A well-proportioned anatomical model, 120.
MCCOY, JOHN C., Traumatic epilepsy, 783.
MCCURDY, STEWART LEROY, Treatment of fracture of the mandible, 630.
MCREYNOLDS, R. P., Intestinal perforation in typhoid fever, 131.
MAASS, FRITZ, Method of infection of actinomycosis in man, 292.
MACEWEN, JOHN A. C., Aid to the localization by X-rays of foreign bodies embedded in the tissues, 478.
Malignant œdema, 481.
Mamma, Cystic degeneration of; transformation into carcinoma, 336; Operative possibilities in cases of advanced carcinoma of, 321.

Mandible, Treatment of fracture of, 630.
Massage by plunging into mercury bath, 767.
Mastoid abscess, 599.
Matas's method of treating aneurism, Case of, 493.
MAYO, WILLIAM J., Review of three hundred and three operations upon the stomach and first portion of the duodenum, 30; Treatment of complications of chronic gall-stone disease, 453.
Meckel's diverticulum, Intussusceptions associated with, 712.
Mesenteric arteries, Thrombosis of, 110.
MEYER, WILLY, Intestinal obstruction, 102; Cicatricial stricture of the œsophagus, 104; Tuberculosis of wrist treated by Bier's method, 106; Black vomit with appendicitis, 108; Autoplasty for umbilical hernia, 302; Ventral hernia closed by silver filigree, 302.
MIKULICZ, PROFESSOR RADECKI VON, Surgery of the pancreas, 1.
MILLER, J. MILTON, Diagnosis of intestinal perforation in typhoid fever, 127.
Minot, Text-Book of Embryology, Review of, 469.
MONKS, GEORGE H., Intestinal localization, 574.
MORGAN, WILLIAM E., Fractures of the spine, 312.
MORISON, RUTHERFORD, Ascites due to liver cirrhosis treated by operation, 361.
Morris on Surgical Diseases of Kidney and Ureter, Review of, 155.
MORRIS, ROBERT T., Case of fusiform aneurism treated by Matas's method, 493.
Moynihan on the Surgical Treatment of Gastric and Duodenal Ulcers, Review of, 466.
MURPHY, JOHN B., Fractures of the spine, 313; Results obtainable by operative measures in affections of the stomach, 789.
MURRAY, R. W., Idiopathic dilatation of the colon, 736.
Muskelphysiologie, Specielle; Review of du Bois-Reymond's Treatise on, 316.
Myositis ossificans traumatica, 423.

N

Nasal fractures and deformities, Bridge for treatment of, 441.
Neck, congenital fistulæ of, Improved method of treating, 759; tuberculous glands of, Subcutaneous excision of, 901.
NEILSON, THOMAS R., Rupture of liver and laceration of kidney; Recovery after operation, 121.
Nerve transplantation for relief of facial paralysis, 901.
New York Surgical Society, Transactions of the, 99, 111, 300, 444, 449, 597.

O

Obstetrics, Review of Reynolds and Newell's Text-Book of, 318; Review of Hirst's Text-Book of, 319; by American Authors, Review of, 475; Text-Book of, by Henry J. Garrigues, Review of, 937.
Œdema, Malignant case of, 481.
Œsophagus, Cicatricial stricture of the, 104.
Omentum, Torsion of the, 99.
ONUF, B., Perforating gunshot wound of the cervical portion of the spinal cord, 812.
Opie on Disease of the Pancreas, Review of, 463.
OWENS, JOHN E., Fractures of the spine, 314; Fractures of the vertebræ, 388.

P

Pancreas, Opie on Diseases of, Review of, 463; Relation of Affections of, to gall-ducts, 924; Surgery of the, 1.

Pancreatitis, acute, Diagnosis and Treatment of, 603, 726; hæmorrhagic, Pathogenesis and therapy of, 917.

Parotid gland, Recurrent endothelioma of the, 111.

Pathological Anatomy and Histology, Review of Lazarus-Barlow on the Elements of, 158.

Peck, Charles H., Torsion of the omentum, 101; Plastic after excision of epithelioma of the cheek, 113; Tumor of male breast, 450; Condition of intestine two years after extensive resection, 451.

Penrose, Charles B., Cases illustrating fracture in the lower animals, 888.

Peptic ulcer of stomach after gastro-enterostomy, 913.

Perineal section, New method of, without guide, 518.

Peritonitis, diffuse, Treatment of, 265; Due to catheter in peritoneal cavity, 446; Pneumococcus, 918.

Phelps, A. V., Fatal hæmorrhage from trephining, 487.

Philadelphia Academy of Surgery, Transactions of the, 119, 888.

Pilcher, James Taft, Review of Cunningham's Manual of Practical Anatomy, 939.

Pilcher, Lewis Stephen, Operative possibilities in cases of advanced carcinoma of the breast, 321; Perforating gunshot wound of the cervical portion of the spinal cord, 812.

Pilcher, Paul Monroe, Review of J. Bland-Sutton on Tumors, 932; Review of Palmer Findley on Diagnosis of Diseases of Women, 933; Review of Thomas S. Cullen on Adenomyome des Uterus, 934.

Plaster-of-Paris dressings, Method of retaining ends of fractured bones in apposition during fixation by, 415.

Pneumococcus peritonitis, 918.

Pneumonia, Acute lobar, followed by embolic gangrene of leg, 380.

Prostatectomy, perineal, Prostatic tractor for, 359.

Prostatic hypertrophy, Beginning, 925; Results of operations for, 306; Surgical problem in, 609.

Pusey on the Practical Application of the Röntgen Rays in Therapeutics and Diagnosis, Review of, 468.

Pyosalpinx, Surgery of, 540.

R

Ransohoff, Joseph, Fatal hæmorrhage from trephining, 487.

Rectum, Resection of, through abdomen, 916.

Regional Minor Surgery, Review of Van Schaick on, 157.

Reynolds and Newell's Text-Book of Practical Obstetrics, Review of, 318.

Ribs, Osteoplastic flap of arch of, for exposing hypochondriac and epigastric regions, 764.

Robinson, Byron, Paraffin casts of ureteral calyces, pelves, and ureters, 375.

Robinson, Ernest F., Tropical abscess of the liver, 560.

Rodman, William L., Intestinal perforation in typhoid fever, 129.

Roe, W. J., Bilateral bony ankylosis of temporomaxillary articulation, 212.

Röntgen Rays, Practical Application of, in Therapeutics and Diagnosis, Review of Pusey on, 468; Use of, for localization of for-

eign bodies embedded in the tissues, 478.
ROGERS, JOHN, JR., Chemical hypothesis for the etiology of cancer, 280; Chemistry of the blood in cancer; Hypothesis for etiology of cancer, 444.

S

Scaphoid bone, carpal, Dislocation of the, 97.
Scapula, Removal of, for sarcoma, 308, 602; Sarcoma of, 115.
SCOTT, J. ALISON, Intestinal perforation in typhoid fever, 130.
SHELDON, JOHN E., Dislocation of the outer end of the clavicle, 403.
SHEPHERD, FRANCIS J., Treatment of aneurism of external iliac artery by digital compression, 498.
Shock, temperature relationship existing in, Experimental research into, 843.
Shoulder, irreducible dislocation of, Operation for, 449.
Skin flaps, Transplantation of, by Krause's method, 766.
Skull, Traumatic defects of, and their closure, 893.
SPELLISSY, JOSEPH M., Intestinal perforation in typhoid fever, 131.
Sphenoid, Empyema of, and intracranial complications, 137.
Spinal cord, perforating gunshot wound of the cervical portion of, Recovery after, 812.
Spine, Surgical treatment of fractures of the, 310.
Spleen, Injuries of the, 147; Rupture of, 123; Transpleural laparotomy for stab wounds of the, 148.
Splenectomy for Banti's disease, 671.
Splenic surgery, Contribution to, 916.
STEWART, FRANCIS T., Cases of intestinal resection, 135.
Stomach, Bullet wound of, 450; carcinoma of, Anatomical and clinical researches in, 911; carcinoma, Surgery of, at Clinic of Krönlein, 1881–1902, 920; "Hour-Glass," 593; Mayo's review of operations upon, 30; Peptic ulcer of, after gastro-enterostomy, 913; Results obtainable by operative measures in affections of the, 789.
STRATTON, ROBERT THOMPSON, Gradual surgical occlusion of large arteries, 256.
Subclavian artery, Traumatic aneurism of, produced by fractured clavicle, 638.
Surgery, Review of Brewer's Text-Book of, 927.
Sympathectomy for exophthalmic goitre, 161.

T

TAYLOR, WILLIAM, Traumatic aneurism of the left subclavian artery produced by fracture of the clavicle, 638.
Temperature relationship existing in shock, Experimental research into, 843.
Temporomaxillary articulation, bilateral bony ankylosis of, Surgical treatment of, 212.
Tenoplasty for flat-foot, 150.
Thorax, Resection of, in old tuberculous empyema, 908.
Thrombosis of the mesenteric arteries, 110.
Thyroidectomy for exophthalmic goitre, 161.
Trendelenburg posture, The dangers of the, 897.
Trephining, Fatal hæmorrhage from, 487; for traumatic epilepsy, 783; for Jacksonian epilepsy, 898.
Tuberculosis of the wrist-joint, Bier's method for, 106; of the female urinary tract, 524.
Tuberculous glands of neck, Subcutaneous excision of, 901.

Tumors, J. Bland-Sutton's Treatise on, Review of, 932.
Turbinate bone, inferior ethmoidal, Anatomy of, 233.
Typhoid fever, Three successful laparotomies for intestinal perforation in, 63, 127; Surgical features of perforation of the intestine in children, 71.

U

Ulnæ, Congenital dislocation of both, at the wrists, 119.
Ulnar nerve, recurrent dislocation of, Operative treatment of, 652.
Umbilical hernia, Radical cure of, 118.
Ureter, Rectal implantation of, 445; Removal of, with tubercular kidneys, 524.
Ureteral calyces, pelves, and ureters, Paraffin casts of, 375.
Urinary tract, female, Tuberculosis of, 524.
Uterus, Adenomyome des, von Thomas O. Cullen, Review of, 934.

V

Van Schaick, Regional Minor Surgery, Review of, 157.
Varicose veins of leg, Treatment of, 765.
Vertebræ, Fractures of the, 388.

W

Wharton, Henry R., Removal of loose fragment of bone from the knee-joint, 126.
White, George R., Review of Eisendrath's Text-Book of Clinical Anatomy, 936.
Willard, De Forest, Case of ruptured gall-bladder, 122.
Willis, Circle of, Anomalies in, 878.
Wilson, H. Augustus, Removal of a large loose fragment of bone from knee-joint, 124.
Women, Diagnosis of Diseases of, by Palmer Findley, Review of, 933.
Wood, Walter C., Review of An American Text-Book of Surgery, 929.
Woolsey, George, Treatment of stricture of the œsophagus, 105; Thrombosis of mesenteric artery, 111; Recurrent endothelioma of the parotid gland, 111; Late suppuration after injuries of the skull, 117; Complete extirpation of bladder for carcinoma, 445; Rubber catheter in peritoneal cavity, 446; Applied Surgical Anatomy regionally presented, Review of, 470; Diagnosis and treatment of acute pancreatitis, 603, 726.
Wrist-joint, Tuberculosis of, treated by Bier's Method, 106.

Z

Zondek, Die Topographie der Niere und ihre Bedeutung für die Nieren-chirurgie, Review of, 459.

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TABLE OF CONTENTS.

ORIGINAL MEMOIRS.

A Method of Suturing the Peritoneum. By 769

The Gall-bladder: Two Hundred Cases Treated by Cholecystostomy and Cholecystectomy: Technique. By 773

Traumatic Epilepsy: Report of a Case Operated on by Trephining and Incision of a Cerebral Clot beneath the Sprain. By 786

On the Results obtainable by Operative Measures in Affections of the Stomach. By 796

Intestinal Obstruction following ..... an Accessory Left Inguinal Hernia due to Loop of Small Intestine caught in ..... By 807

Perforating Stabbed Wound of the Cerebral ..... Recovery 820

Local Anæsthesia. By 824

VIII. An Experimental Research into the Temperature Conditions existing in Shock. By 843

150 Anomalies in the Circle of Willis. With the Report of 4 Cases 852

TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY. 881

INDEX TO SURGICAL PROGRESS. 889

REVIEWS OF BOOKS. 922

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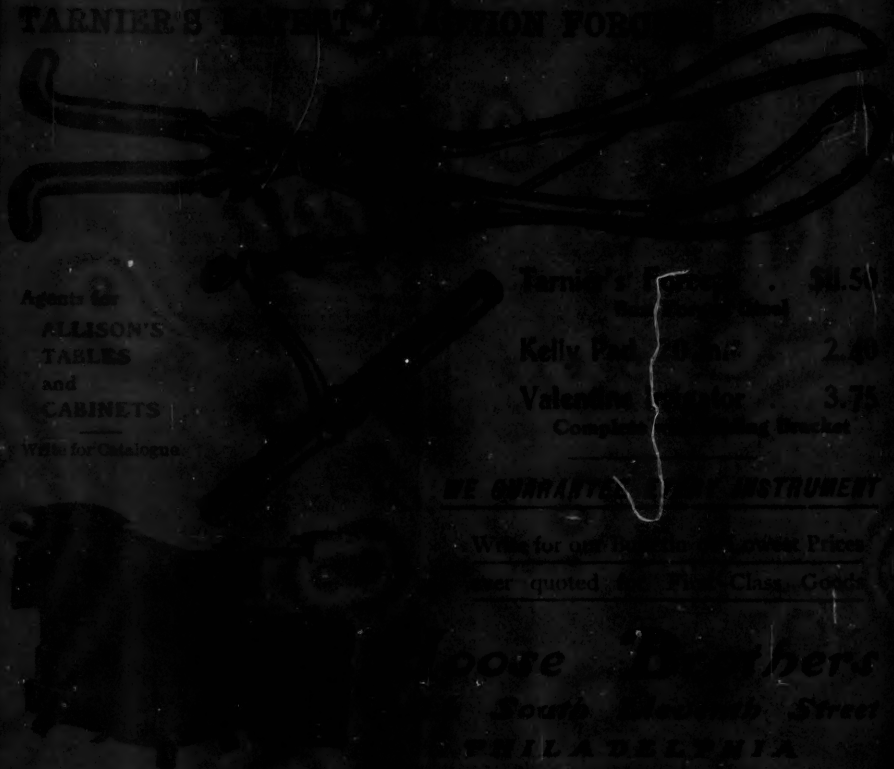

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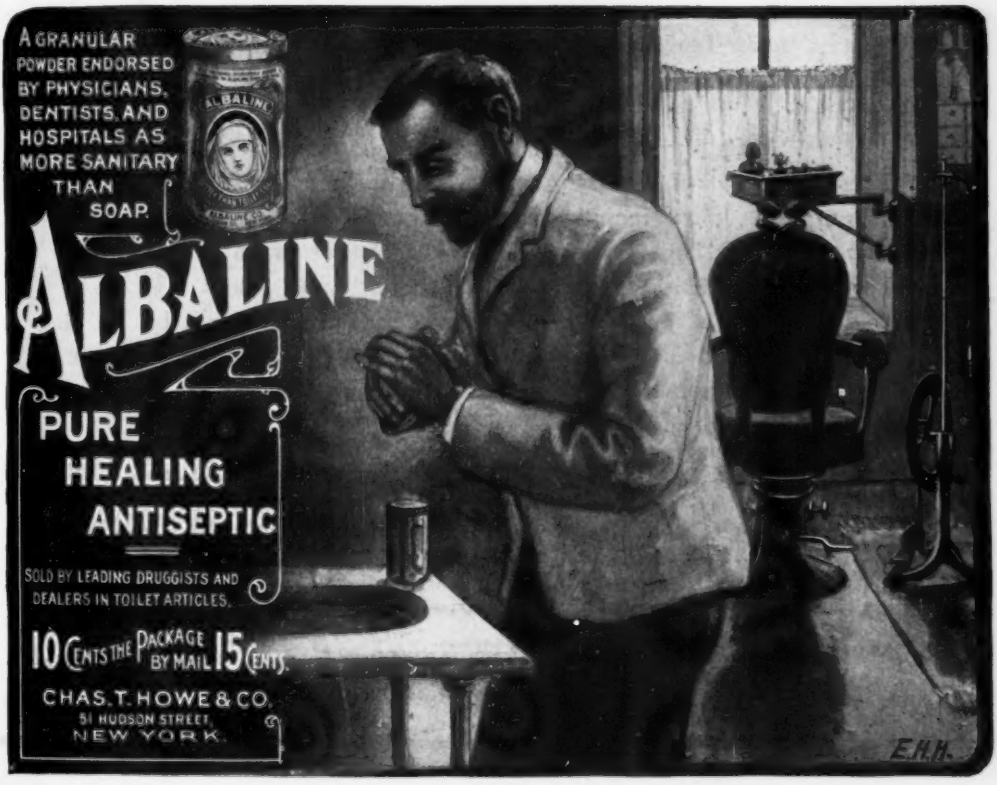
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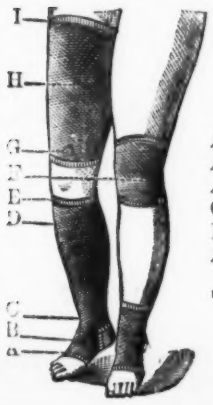

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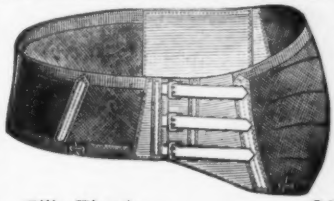

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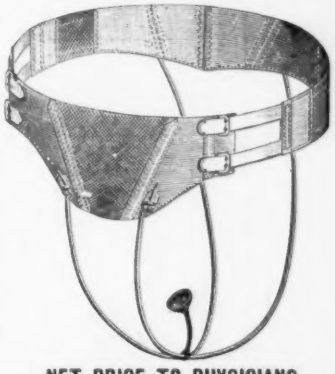

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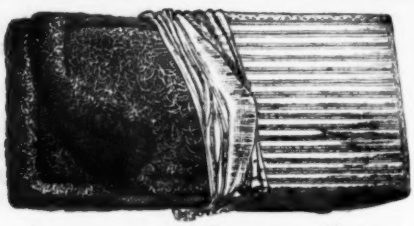

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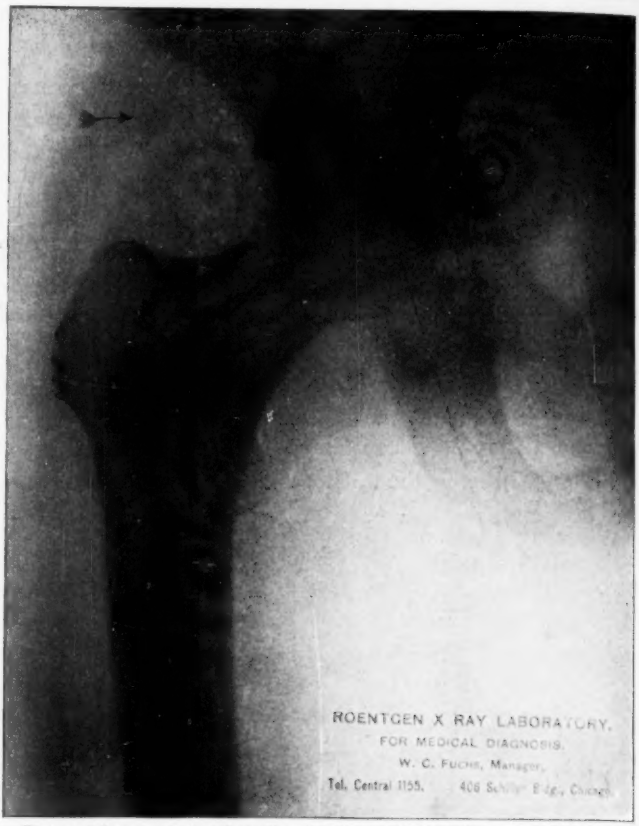

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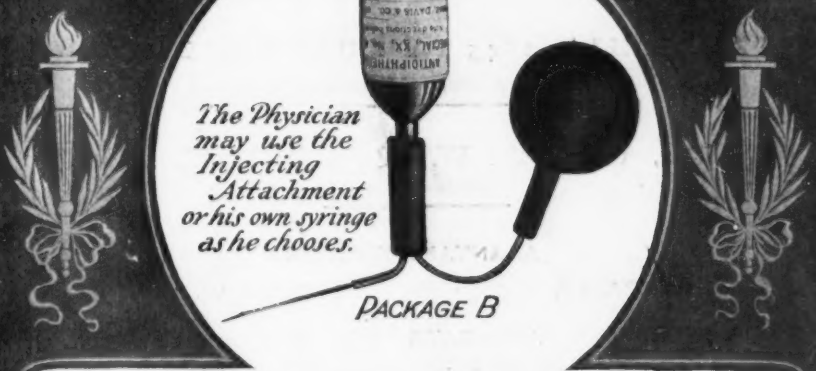

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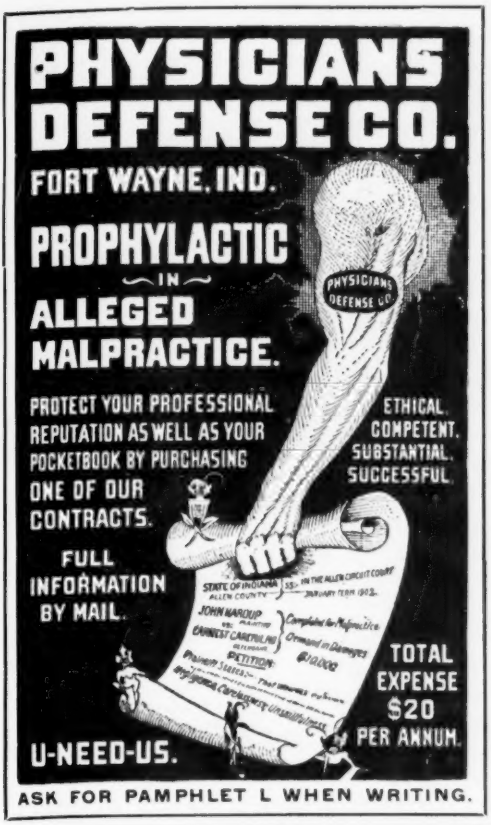
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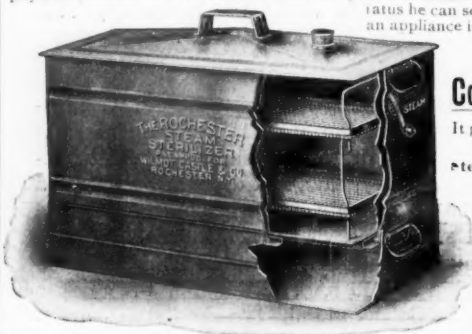

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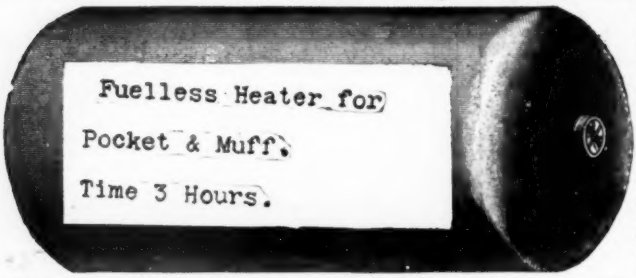

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COLLARGOLUM IN SURGICAL INFECTIONS.

Professor Netter read a paper with this title before the Paris Pediatric Society, Jan. 20, 1903 (*Bulletins de la Société de Pédiatrie*, Jan., 1903). He divides the infections which he combated with Collargolum into the following classes:

Cases in which suppuration was not established or was just beginning to appear. In these, not only was pus collection hindered by Collargolum, but absolute retrogression was effected. An empyema accompanying a pneumonia was absorbed on the sixth day after an intravenous Collargolum injection followed by an inunction of Unguentum Credé. In a typhoid suppurative periostitis resolution was complete after six inunctions.

Cases of localized suppurations, superficial and deep. In no case did Collargolum render surgical interference dispensable. But it certainly limited the extension of the process, very favorably modified the general condition, lowered the temperature, and hastened repair and cicatrization. Professor Netter treated with it one submental abscess, one suppurative submaxillary adenitis, one abscess of the breast in a wet-nurse, two purulent pneumococcal pleurisies, and one suppurative mastoiditis following scarlatina. In a case of appendicitis, in which grave symptoms of peritonitis appeared, despite operation, several inunctions promptly modified the condition.

Cases of multiple suppuration. Professor Netter used Unguentum Credé on an infant of five and one-half months, suffering from heredo-syphilis, having had six attacks of suppurative pneumococcal arthritis in addition to epiphysial separations. The case was hopeless and cannot be counted for or against the remedy.

Cases of general pyemia. Three cases of general pyemic infection recovered after intravenous injections. An infectious endocarditis with staphylococci in the blood and a severe puerperal sepsis got well after two injections each. An infant attacked with streptococcal suppurative meningitis following an otitis and mastoiditis died. A case of pyemia only treated with single inunction on the ninety-second day was markedly improved both in the general condition and the local lesion.

As a prophylactic Unguentum Credé was used in two infantile broncho-pneumonias and on one puerpera whose delivery was made in very unclean surroundings. The results therefrom were remarkable.

In the discussion which followed, Dr. Netter said that intoxications have never been observed from Collargolum injections or inunctions. Besides his surgical cases, he has treated severe diphtheria, scarlatina, typhoid fever, and tuberculosis of a pneumonic type with the remedy. He had made many Collargolum injections, and could testify that there is not the slightest danger of infecting the patient if sterile water is used for the solution and if syringe and needle are carefully asepticized.

PYROLIGNEINE.

"Nelson, Kan., May 15, 1903. Pyroligneine Company:

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"The malar bone was also fractured, and after elevating the depressed bone, pyroligneine was applied with the happiest results. I use it often in minor work and feel sure of relief from pain, in contusions, fractures, cuts; also that there will be no inflammatory symptoms or pus, but that the wound will be dry and clean, and heal with all possible dispatch. I have never found anything so handy and efficient, or in which I had equal confidence.

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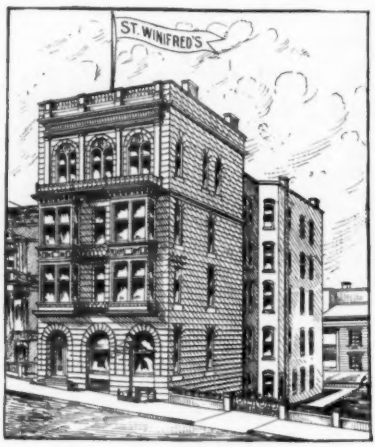

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PUERPERAL SEPSIS.

J. Clifton Edgar, M.D., recently read a paper of especial value before the New York Academy of Medicine which illustrates the need of prophylactic measures in these cases. He said that endometritis was the most common lesion in cases of puerperal sepsis, and named two principal varieties, septic and putrid. He showed that frequently the process started from a vaginitis. With regard to prophylaxis, the speaker urged the necessity of great personal cleanliness on the part of both physician and nurse, with special precaution on the limitation of internal examination. With proper asepsis before, during, and after parturition, the danger of endometritis is unminimized. In this connection we would mention the value of Glyco-Thymoline for irrigation purposes in these cases. This preparation, while strongly antiseptic, is non-toxic and non-irritating, and its action is to deplete inflammatory engorgements by rapid exosmosis, drawing outward through the capillaries the products of inflammation. This action checks reabsorption of ptomaines and produces a degree of asepsis that is unsuitable for the further propagation of pathogenic bacteria. Bearing on this subject, T. R. Maxfield, of Brooklyn, N. Y., states:

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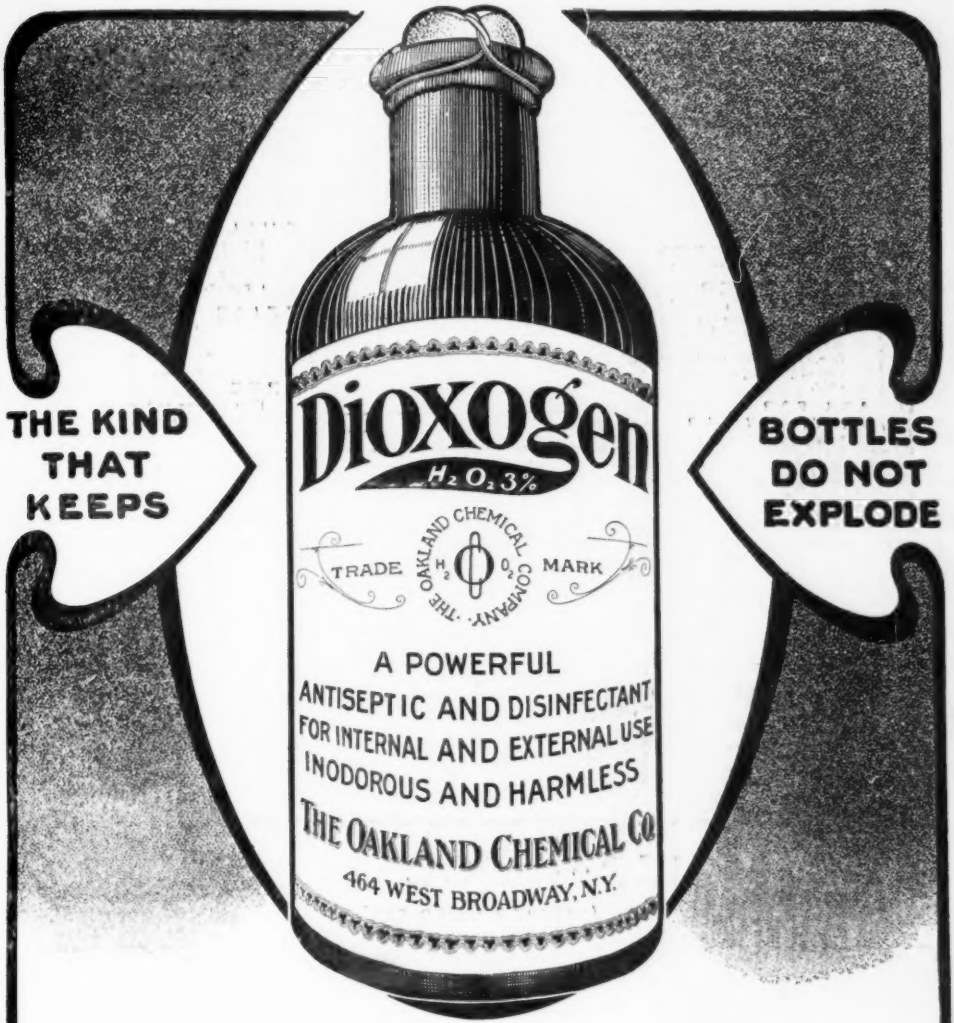

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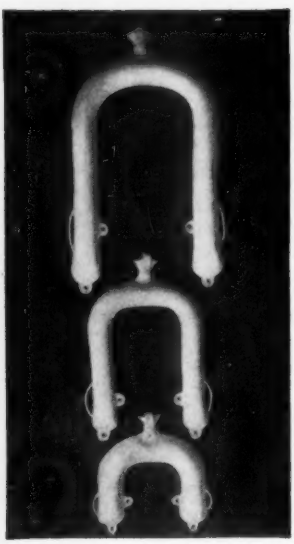

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